BARLEY IN CANADA

CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS

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THE NATIONAL BARLEY COMMITTEE

206 GRAIN EXCHANGE BUILDING

WINNIPEG, MANITOBA

BARLEY IN CANADA

CONTENTS

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Let husky Wheat the haughs adorn,
An' Aits set up their awnie horn,
An' Pease and Beans at een and morn
Perfume the plain.
Leeze me on thee, John Barleycorn,
Thou King o' grain!

ROBERT BURNS

FOREWORD

DR. H. BARTON[1]

Dominion Department of Agriculture, Ottawa, Can.

BARLEY is generally recognized as one of the world's most important fat and energy producing foods. Among the grains produced in Canada, barley occupies first place as a fattening and finishing feed for livestock.

¶ Its importance has not been overlooked by those in charge of crop and livestock improvement. Early crop breeding experiments resulted in the development of an outstanding variety which is now grown throughout the Dominion. Experimental work in the feeding of barley to hogs and other classes of livestock did much to acquaint the farmer with the importance of this crop.

¶ In addition to its usefulness as a stock feed, there has been a fluctuating demand for barley for malting purposes. In recent years this demand has increased with the result that cash prices for high quality barley have at times been out of line with the value of barley for feeding purposes. At other times livestock prices have been too low to support any strong demand for even the lower feed grades. As a result of these difficulties, investigations have been conducted periodically into various phases of the barley situation.

¶ At the National Conference on Agricultural Services held in Toronto in 1932 it was felt that in view of the critical wheat situation some definite action should be taken to shift production where economically feasible to other grains, and particularly to barley in view of its close relation to bacon hog production. This attitude was further emphasized at the time of the World's Grain Exhibition and Conference in Regina in 1933. The National Advisory Committee on Agricultural Services accordingly appointed a National Barley Committee to act as a permanent co-ordinating medium for investigational and promotional work. This committee has functioned admirably, as may be learned from various reports published from time to time.

¶ With the purpose of providing a brief but comprehensive review of the situation, the National Barley Committee has co-operated with the Canadian Society of Technical Agriculturists in preparing a series of papers on different aspects of the barley problem. This popular review is supplemented by a reference list of technical papers written by various members of the committee. It is hoped that the publication of this review of the Canadian barley situation will stimulate interest in the production and marketing of this very important grain in the light of the best information available.

1 Deputy Minister of Agriculture.

THE ORGANIZATION OF BARLEY INVESTIGATIONS

THE NATIONAL BARLEY COMMITTEE

T. J. HARRISON [1]
Board of Grain Commissioners for Canada, Winnipeg, Manitoba

The National Barley Committee was established in 1933 as a sub-committee of the National Advisory Committee on Agricultural Services. The object is to promote the interests of the barley industry in Canada by stimulating and co-ordinating the efforts of the various departments and branches of the Dominion and Provincial Governments, and all other organizations interested in the production, marketing, transportation, processing, research and utilization of barley. The organization provides for three groups of members, namely, members of the executive, active members of the committee and associate members of the committee. The first two groups are appointed by the National Advisory Committee on Agricultural Services and the last group is elected by the National Barley Committee. There are three executive members, twenty active members, and fifty-five associate members representing different phases of the barley industry. The associate members have all the privileges of active members except voting power.

ASSOCIATE COMMITTEES

Committees set up by other organizations dealing with related problems are invited to associate themselves with the National Barley Committee. Two such committees have associated themselves with the National Committee, namely, the Associate Committee on Grain Research of the National Research Council and the Dominion Department of Agriculture, and a Special Committee on Barley Markets appointed by the Dominion Department of Agriculture.

Associate Committee on Grain Research

Through the efforts of the Grain Research Committee research on barley is being organized on a sound basis. The National Research Council has equipped a Barley Research Laboratory at Ottawa, under the direction of Dr. J. A. Anderson, which will attack the more fundamental problems. The Manitoba Barley Research Laboratory at the University of Manitoba, will carry on general investigational work, while the commercial laboratories of the Canada Malting Company Limited, and the Dominion Malting Company, Limited, will co-operate. An outline of the work of this Committee is presented elsewhere in this issue.

Special Barley Committee of the Dominion Department of Agriculture

The Department of Agriculture felt the need for very definite information on the use of barley for feed. A committee composed of departmental officials was appointed to investigate the matter. Since the work

[1] Assistant Grain Commissioner and Chairman of the National Barley Committee.

of this committee might have conflicted with the work of the sub-committee on Marketing, it was decided to have the Special Committee act as an associate committee, and by means of joint conferences apportion the work and receive reports. This committee did an excellent piece of investigational work, and a résumé of their report is presented in this series of papers.

SUB-COMMITTEES

The National Barley Committee may at any regular meeting appoint a sub-committee on any phase of the industry, the personnel being named by the executive. Thus far six sub-committees have been appointed, the work of which is outlined below.

Sub-Committee on Plant Breeding and Production

This committee is working on a most extensive and well co-ordinated programme of both plant breeding and agronomic projects. As will be noted in the personnel, it is composed of representatives of the leading plant breeding institutions and grain handling organizations throughout Canada.

Plant Breeding:—The main purpose of this committee is to develop better malting and feeding barleys for the different areas in Canada, and to combine with the market qualities good agronomic properties such as yield, disease-resistance, strength of straw, smooth-awns and absence of "necking", and other desirable qualities. The work to date has produced a number of promising new types which are still being tested.

Variety Testing:—Variety testing is probably one of the most outstanding projects of this committee, being a co-operative endeavour participated in either directly or indirectly by practically all members.

Crop Testing:—Crop testing has been carried on as a co-operative project with the elevator companies, Experimental Farms, Universities, Dominion Seed Branch and the Canada Malting Company, Limited. The results indicate that about 25% of the barley grown for malting is very undesirable, being mixtures of inferior sorts, 50% comprising mixtures of varieties of barley which make only fair malt, while only 25% are pure as to variety and can be classed as good malting barley.

Seed Improvement:—This project is designed to assist in the improvement of seed used by both the average and poor quality grower. Local elevator operators try to get the poor quality growers to exchange their seed for some of the good quality seed. Then through the co-operation of the Canadian Seed Growers' Association and elevator companies registered seed is distributed to good growers in the district. The Junior Barley Seed Clubs are also encouraged in this effort and registered seed is supplied to groups of junior farmers, sources of good seed being thus established. The last part of the project is carried on by the Canada Malting Company, the elevator companies and the departments of agriculture through their extension service.

Barley Zoning:—The zoning of the country into malting and feed barley areas, and the further zoning of malting areas into high and low protein districts, is progressing slowly. From the mass of data accumu-

lated from the variety testing project, the protein survey and the malting tests, it is possible to draw at least tentative boundaries around those districts that should specialize in growing malting barley.

Sub-Committee on Marketing and Transportation

Owing to the fact that the Special Barley Committee of the Department of Agriculture referred to previously has been working on the domestic market problems, the sub-committee on Markets has concentrated its energies on the export market.

The Feed Barley Market:—It would appear that in the overseas feed market, price is the governing factor. The quality, however, is also important, since in the United Kingdom feed barley is distributed to the feeders in the form of barley meal which is sold under the jurisdiction of the British Feeding Stuffs Act. The Committee is recommending to the Board of Grain Commissioners for Canada that in the revision of the barley grades the feed grades be made to conform to the British regulations. Through the offices of Canadian Trade Commissioners it is planned that an active campaign for the use of Canadian barley will be instituted as soon as Canada has a sufficient quantity of feed barley to export.

The Malting Barley Market:—In the malting market considerable effort has been made to interest particularly the diastatic malt manufacturers in Canadian barley. The efforts of the committee have been directed towards having articles on Canadian barley published in the British scientific and trade journals. Dr. J. A. Anderson of the National Research Council prepared a most comprehensive article which was published in the Journal of the Institute of Brewing, and several extracts of this article were published in the various trade journals. In addition to this, the Secretary of the National Barley Committee prepared some short articles which were published in trade journals. News-letters on the "Canadian Barley Situation" were also distributed to barley users and the barley trade in Great Britain. Several projects in a definite endeavour to interest the United Kingdom in Canadian barley were undertaken. Following the distribution of the report on the barley protein survey made by Dr. W. G. Geddes, Research Laboratory, Board of Grain Commissioners, requests were received from A. Guinnes, Son & Company, Dublin, Ireland, for samples of low-protein barley from the Melfort-Tisdale area in Saskatchewan. Some thirty-seven samples were secured by the Pool and forwarded to this organization through the Canadian Trade Commissioner in Dublin.

The second phase of this project originated from a large malting concern with headquarters in London. This organization uses fairly large quantities of Canadian barley and required for experimental purposes 10 tons of six-rowed, two-rowed and Trebi 3 Extra CW. Sales were made of the six-rowed and two-rowed, but no Trebi could be obtained. While information is not available, it was presumed that this test was for the purpose of evaluating Canadian barley in the brewing trade.

The Pot and Pearl Barley Market:—James Proctor & Sons, Limited, Liverpool, have received each year samples of varieties and official grades

of Canadian barley. This year they asked specially for representative samples of two-rowed barley. These were forwarded and while they were not entirely satisfactory, it is understood that purchases were made of Canadian two-rowed by this Company.

The Segregation Project:—The segregation project was one instituted by the Saskatchewan Pool Elevators Limited and the Manitoba Pool Elevators Limited. These organizations segregated some 40,000 bushels of high diastatic barley of No. 3 Extra C.W. grade and had it moved forward to one of the lower lake ports. Samples were put up by the Committee and forwarded to the Dominion Trade Commissioners in the United Kingdom, who undertook to distribute the samples to the manufacturers of diastatic malts with the assurance that they could obtain cargoes similar to the samples. The National Barley Committee has requested all those who made purchases to report to the Committee as to how satisfactory these lots of barley were for their particular trade. From this endeavour, it is hoped to learn considerable about the requirements of the diastatic malt market in the United Kingdom. This project stirred up considerable interest in Canadian barley in the United Kingdom market. More than one Canadian exporter expressed the opinion that this work was well worth while.

Sub-Committee on Cleaning and Handling

Many complaints were received by the National Committee in regard to the damage done to barley in handling and cleaning. A sub-committee which was appointed to investigate this whole matter has just completed a very interesting and valuable study of the mechanical damage to barley due to threshing, cleaning and handling. The National Research Council undertook to direct the work in co-operation with the Dominion Seed Branch, threshermen, country elevators, terminal elevators, transfer elevators, seaboard elevators and malt houses. In the February, 1936, issue of *Scientific Agriculture*, Dr. J. G. Malloch reported on the first year's work on this project.

Sub-Committee on Western Barley Grades

In 1929 the Western grades of barley were re-defined to suit the existing market. Since that time, several changes have taken place in quality requirements, with the result that the grades do not now entirely suit the consumer. It was found that there were several changes which the barley interests thought desirable. These may be summarized as follows: (1) The elimination of the Trebi grades. (2) That the number of grades be reduced and that since No. 1 CW Six-Row and 1 CW Two-Row were never used, these be discontinued. (3) That the nomenclature be made simpler, and especially since the widest spread in both quality and price came between No. 3 CW and No. 3 Extra CW that these should be given names that would indicate this break in quality. (4) That some grade should be introduced between the No. 3 Extra and the No. 3, preferably under the name of No. 3, as this is the grade purchased by Old Country maltsters in spite of the fact it is now considered only a feed grade. (5) That feed grain be made cleaner to suit the demand of the Eastern and Old Country

feeders. (6) That some recognition be given to the smooth-awn sorts. (7) That the names of the grades indicate the uses of the grades; for example, the word "malting" should appear in all malting grades, and the name "feed" should appear in all feed grades. The Committee made up a tentative schedule of grades embodying the above suggestions. These suggestions were then discussed with the various interests, including producers, grain-handling organizations, exporters, feeders, millers and maltsters. After many amendments, a schedule was recommended to the Board of Grain Commissioners to be incorporated in the Canada Grain Act when it again comes up for revision in Parliament.

Sub-Committee on Eastern Barley Grades

At the meeting of the National Committee in 1936, the Eastern barley interests asked that a sub-committee on Eastern Grades be appointed. This was done, and this Committee after studying the situation as it obtains in Eastern Canada submitted its report through the Chairman of the National Committee to the Board of Grain Commissioners.

Sub-Committee on Barley Feeding Experiments and Feed Analysis

At the present time this committee is organizing three projects: (1) determination of digestible nutrient co-efficients; (2) comparative feeding value of barley, corn and oats for hogs; (3) comparative feeding value of the various feed grades of barley.

Digestible Nutrient Co-efficient:—In this project the Dominion Experimental Farms and Macdonald College are co-operating. Since it is a highly technical problem it will take some time before the apparatus can be installed and put in operation. Work on this project will start in the spring of 1937.

Feeding Value of Barley, Corn and Oats:—This is a co-operative project between the Dominion Experimental Farms at Ottawa, Ont., Nappan, N.S., and Ste. Anne de la Pocatière, Que.; Macdonald College, Ste. Anne de Bellevue, Que.; Ontario Agricultural College, Guelph, Ontario; and the Western Grain Pools. The latter are supplying all the feed; the institutions supply the hogs and conduct the experiments.

Feeding Value of Feed Grades:—This project will be undertaken just as soon as the new Western barley grades have been definitely established.

PUBLICITY

The publicity is carried on through the Chairman's office by the Secretary, A. W. Playfair-Harrison, with the assistance of the Publicity and Extension Branch of the Dominion Department of Agriculture. The publicity is of a three-fold nature: (1) To committee members on the work of the committee, sub-committees and associate committees, by means of news letters, pamphlets, etc. When it is realized that there are about seventy-five active and associate members, the necessity of keeping each other informed of the work going on is important, and is no small task. (2) Information to the producers; the findings of the committees as they affect the producer are prepared in the form of press releases and

distributed to the agricultural press and country newspapers; notices and posters are also prepared and displayed in post offices, country elevators, etc. (3) Information to barley users; this consists of news letters, press notices and technical articles in the countries in which Canadian barley is sold.

FINANCE

The National Barley Committee operates without any special funds. The Dominion Department of Agriculture and the Dominion Department of Trade and Commerce finance the office expenses. The Dominion Department of Agriculture also finances most of the publications. Other publications are financed by commercial organizations. The members of the National Committee and all Sub-Committees give their time free, and the organizations that they represent underwrite all other expenses.

CONCLUSION

In conclusion it must be stated that it is not possible in a brief review of this nature to give more than a bare outline of the work of the National Barley Committee. Many workers and co-operating organizations have not been mentioned. This is not because their contributions are not appreciated but because space prohibits doing so. It is hoped, however, that sufficient has been written to indicate the purpose of the Committee, its method of attack, and some of the results achieved.

APPENDIX

NATIONAL BARLEY COMMITTEE

EXECUTIVE:

Chairman: PROF. T. J. HARRISON, Assistant Grain Commissioner, Winnipeg, Man.
Vice-Chairman: DR. L. H. NEWMAN, Dominion Cerealist, Ottawa, Ont.
Honorary Secretary: O. S. LONGMAN, Field Crops Commissioner, Edmonton, Alta.
Secretary: A. W. PLAYFAIR-HARRISON, 206 Grain Exchange Building, Winnipeg, Man.

ACTIVE MEMBERS:

P. F. BREDT, President, Manitoba Pool Elevators Ltd., Winnipeg, Man.
G. W. P. HEFFELFINGER, Northern Elevator Company Ltd., Winnipeg, Man.
PETER C. WATT, United Grain Growers Ltd., Winnipeg, Man.
LEROY D. GODFREY, Broker, Grain Exchange, Winnipeg, Man.
HENRY GAUER, Jas. Richardson & Sons Ltd., Winnipeg, Man.
E. W. CRAMPTON, Assoc. Prof. of Animal Husbandry, Macdonald College, P.Q.
R. S. DUNCAN, Director of Agricultural Representatives, Toronto, Ont.
S. H. VIGOR, Field Crops Commissioner, Dept. of Agriculture, Regina, Sask.
W. T. G. WIENER, Secretary, C. S. G. A., Ottawa, Ont.
PAUL METHOT, Dept. of Agriculture, Quebec, P.Q.
W. V. LONGLEY, Department of Agriculture, Truro, N.S.
BROOKS CATTON, Saskatchewan Pool Elevators Ltd., Hanley, Sask.
LEW HUTCHISON, Alberta Pool Elevators Ltd., Duhamel, Alta.
CECIL TICE, Department of Agriculture, Victoria, B.C.
DR. R. NEWTON, National Research Council, Ottawa, Ont.
DR. G. P. MCROSTIE, Field Husbandry Department, Ont. Agricultural College, Guelph, Ont.
DR. H. C. GRANT, Economics Branch, University of Manitoba, Winnipeg, Man.
GEORGE BAILEY, Canada Malting Company Limited, Winnipeg, Man.
T. G. MAJOR, Dept. of Trade and Commerce, Ottawa, Ont.
NELSON YOUNG, Dominion Seed Commissioner, Ottawa, Ont.

ASSOCIATE COMMITTEE ON GRAIN RESEARCH OF THE NATIONAL RESEARCH COUNCIL AND THE DOMINION DEPARTMENT OF AGRICULTURE

Chairman: DR. R. NEWTON, Director of Biology and Agriculture, National Research Council, Ottawa, Ont.

Secretary: Dr. W. F. Geddes, Chemist-in-charge, Dominion Grain Research Laboratory, Winnipeg, Man.
Prof. T. J. Harrison, Board of Grain Commissioners, Winnipeg, Man.
Dr. R. K. Larmour, Prof. of Chemistry, University of Saskatchewan, Saskatoon, Sask.
Dr. J. G. Malloch, Biologist, Division of Biology and Agriculture, National Research Council, Ottawa, Ont.
Maj. Gen. A. G. L. McNaughton, President, National Research Council, Ottawa, Ont.
Dr. G. P. McRostie, Field Husbandry Department, Agricultural College, Guelph, Ont.
Dr. W. C. Murray, President, University of Saskatchewan, Saskatoon, Sask.
Dr. K. W. Neatby, Prof. of Genetics and Plant Breeding, University of Alberta, Edmonton, Alta.
Dr. L. H. Newman, Dominion Cerealist, Central Experimental Farm, Ottawa, Ont.
C. H. Robinson, Dominion Chemist, Central Experimental Farm, Ottawa, Ont.
Dr. J. M. Swaine, Director of Research, Department of Agriculture, Ottawa, Ont.
Dr. T. Thorvaldson, Prof. of Chemistry, University of Saskatchewan, Saskatoon, Sask.
Dr. L. E. Kirk, Dominion Agrostologist, Ottawa, Ont.

SPECIAL BARLEY COMMITTEE OF THE DOMINION DEPARTMENT OF AGRICULTURE

Chairman: R. W. White, Chief, Feed Division, Dominion Seed Branch, Ottawa, Ont.
Secretary: H. R. Hare, Economics Branch, Department of Agriculture, Ottawa, Ont.
P. E. Light, Markets Intelligence Division, Dominion Live Stock Branch, Ottawa, Ont.
A. W. Peterson, Chief, Field Service, Dominion Live Stock Branch, Ottawa, Ont.
S. C. Barry, Poultry Division, Dominion Live Stock Branch, Ottawa, Ont.
Geo. H. Muir, Dominion Animal Husbandman, Central Experimental Farm, Ottawa, Ont.
Consultant Member: C. B. Davidson, Statistics Branch, Canadian Wheat Board, Winnipeg, Man.

SUB-COMMITTEE ON PLANT BREEDING AND PRODUCTION

Chairman: Dr. L. H. Newman, Dominion Cerealist, Central Experimental Farm, Ottawa, Ont.
Vice-Chairman: Dr. K. W. Neatby, Field Crops Department, University of Alberta, Edmonton, Alta.
Secretary: P. R. Cowan, Cerealist in charge of Barley Investigation, Central Experimental Farm, Ottawa, Ont.
Dr. J. B. Harrington, Field Husbandry Department, University of Saskatchewan, Saskatoon, Sask.
Dr. G. P. McRostie, Dept. of Field Husbandry, Ontario Agricultural College, Guelph, Ont.
Prof. E. A. Lods, Agronomy Department, Macdonald College, P.Q.
Dr. E. S. Hopkins, Dominion Field Husbandman, Central Experimental Farm, Ottawa, Ont.
Dr. W. F. Geddes, Grain Research Laboratory, Board of Grain Commissioners, Winnipeg, Man.
Dr. J. A. Anderson, National Research Council, Ottawa, Ont.
Consultant Members:
Major H. G. L. Strange, Director of Research, Searle Grain Company Ltd., Winnipeg, Man.
W. A. MacLeod, Director of Publicity, Canadian Co-operative Wheat Producers Ltd., Winnipeg, Man.
A. T. Elders, Director of Field Work, Canada Malting Company Ltd., Winnipeg, Man.
F. L. Dickinson, Director of Seed Improvement, United Grain Growers Ltd., Winnipeg, Man.

SUB-COMMITTEE ON MARKETING AND TRANSPORTATION

Chairman: T. G. Major, Department of Trade and Commerce, Ottawa, Ont.
Vice-Chairman: Prof. T. J. Harrison, Board of Grain Commissioners, Winnipeg, Man.
Secretary: H. R. Hare, Economics Branch, Department of Agriculture, Ottawa, Ont.
P. F. Bredt, Manitoba Pool Elevators Ltd., Winnipeg, Man.
Henry Gauer, Jas. Richardson & Sons Ltd., Winnipeg, Man.
P. C. Watt, United Grain Growers Ltd., Winnipeg, Man.
LeRoy D. Godfrey, Broker, Grain Exchange, Winnipeg, Man.
Dr. J. F. Booth, Economics Branch, Department of Agriculture, Ottawa, Ont.
Dr. H. C. Grant, Economics Department, University of Manitoba, Winnipeg, Man.
Dr. J. A. Anderson, National Research Council, Ottawa, Ont.

SUB-COMMITTEE ON CLEANING AND HANDLING

Chairman: Dr. R. Newton, National Research Council, Ottawa, Ont.
Vice-Chairman: R. C. Steele, Manitoba Pool Elevators Ltd., Winnipeg, Man.
Secretary Dr. J. G. Malloch, National Research Council, Ottawa, Ont.
P. C. Watt, United Grain Growers Ltd., Winnipeg, Man.
Geo. Bailey, Canada Malting Company Ltd., Winnipeg, Man.
R. Hetherington, Canadian Government Elevators, Fort William, Ont.

SUB-COMMITTEE ON WESTERN BARLEY GRADES

Chairman: Prof. T. J. Harrison, Board of Grain Commissioners, Winnipeg, Man.
Vice-Chairman: Dr. G. P. McRostie, Ontario Agricultural College, Guelph, Ont.
Secretary: J. D. Fraser, Chief Grain Inspector, Winnipeg, Man.
Dr. J. B. Harrington, Field Husbandry Department, University of Saskatchewan, Saskatoon, Sask.

SUB-COMMITTEE ON EASTERN BARLEY GRADES

Chairman: Dr. L. H. Newman, Dominion Cerealist, Central Experimental Farm, Ottawa, Ont.
Secretary: W. R. White, Dominion Seed Branch, Ottawa, Ont.
J. P. Heighton, Canada Malting Company, Toronto, Ont.
Fred Presant, Toronto Elevator Company, Toronto, Ont.
J. D. Smith, Department of Agriculture, Toronto, Ont.
J. D. Fraser, Chief Grain Inspector, Winnipeg, Man.

SUB-COMMITTEE ON BARLEY FEEDING EXPERIMENTS AND FEED ANALYSES

Chairman: Prof. E. W. Crampton, Macdonald College, P.Q.
Secretary: C. H. Robinson, Chemistry Division, Central Experimental Farm, Ottawa, Ont.
Geo. W. Muir, Dominion Animal Husbandman, Central Experimental Farm, Ottawa, Ont.
W. R. White, Dominion Seed Branch, Ottawa, Ont.
Prof. R. G. Knox, Dept. of Animal Husbandry, Ontario Agricultural College, Guelph, Ont.
Prof. G. W. Wood, Dept. of Animal Husbandry, University of Manitoba, Winnipeg, Man.
Prof. J. W. G. MacEwan, Dept. of Animal Husbandry, University of Saskatchewan, Saskatoon, Sask.
Dr. W. F. Geddes, Dom. Research Laboratory, Board of Grain Commissioners, Winnipeg, Man.
Prof. R. D. Sinclair, Dept. of Animal Husbandry, University of Alberta, Edmonton, Alta.

A field of 3rd generation registered barley in Western Canada that produced 70 bushels per acre.

LABORATORY RESEARCH ON MALTING BARLEY

J. A. Anderson [1]
National Research Council, Ottawa

Laboratory research on malting barley in Canada is being concentrated on the development of more precise methods and equipment for malting small samples of barley and for evaluating the quality of the malt produced. The need for this work is apparent when one considers that the plant breeder who is endeavouring to produce new varieties of barley with improved agronomic and malting characters, and the investigator who is studying the effect of environmental conditions on malting quality, are unable to make progress in their work without the aid of a precise test for malting quality which can be applied to a small sample of barley.

The National Barley Committee has turned over this phase of its work to the Associate Committee on Grain Research of the National Research Council and the Dominion Department of Agriculture. In April 1935, the latter committee set up a Sub-committee on Methods of Experimental Malting and Malt Analysis on which the Canada and Dominion Malting Companies, the National Research Council and the Malting Laboratory at the University of Manitoba are represented. After studying the laboratory malting plants at the universities of Minnesota, Wisconsin and Manitoba, new malting equipment was designed, approved by the sub-committee, and installed in the National Research Laboratories in March, 1936.

The equipment consists of duplicate steep tanks, germination chambers and kilns, each set having a capacity of eight 350-gm. samples per week. It was designed essentially for research on laboratory malting methods, rather than for immediate use in making routine tests, and it was therefore made as flexible as possible in order that different methods of malting such as the use of stationary or revolving cages could be studied, and in order that various parts of the equipment could be modified or entirely rebuilt without damage to other parts of the equipment.

The problem facing the investigators is the reverse of that which faces the engineer, who must translate laboratory practice into commercial plant practice. Although there is a vast literature on commercial malting methods and on the effect of changes in malting conditions on the quality of the malt, this information can serve only as a guide in developing small-scale methods.

During the past eight months 240 samples of malt have been made in the Ottawa plant under 90 different sets of conditions. The preliminary investigations included a series of "trial and error" experiments designed to establish a reasonably satisfactory malting method, and to "tune up" the equipment, a process involving the making of various minor modifications in it and the selection and installation of suitable heating units and control instruments. The work has now progressed to a stage at which a systematic study can be undertaken of the effects of varying the conditions

[1] Biologist.

under which the samples are steeped, "floored" and kilned on the quantity and quality of the malt produced. These studies have already led to the selection of a set of conditions and a technique by means of which reproducible results can be obtained and malts very similar to those produced in commercial malting can be made, but further refinements are required before the malting test can be considered really satisfactory.

The future programme of investigations includes a rigorous study of the significance of the malting test. All existing tests measure not the inherent malting quality of a sample but its response to a standard set of malting conditions. It is thus possible that two varieties of barley might be placed in a given order with respect to malting quality when tested by the standard malting method, but that this order might be reversed, or at least that the relation between the varieties might be changed, if the malting conditions were changed. Until the quantitative aspects of this problem have been thoroughly studied, the laboratory malting test cannot be recognised as a reliable tool for scientific investigations.

The Sub-committee on Methods has also undertaken a study of the various analytical methods used in the evaluation of the quality of malt. Co-operative investigations have shown that these methods are subject to various errors which make it extremely difficult to obtain concordant results for the analyses of the same malts in different laboratories. Some progress has been made in determining and eliminating the various sources of error. In this connection a new method for determining diastatic power has been developed. It is now being studied in the four co-operating laboratories, and reports indicate that it is more precise and considerably more rapid than the older methods.

The research programme of the National Barley Committee contains, in its wider aspects, a number of field investigations. These include studies of the effects of soil and climatic conditions, dates and rates of seeding, fertilizers, and crop rotations on malting quality, which are being made at the western universities. In addition, plant breeding work and varietal tests are being carried on by the Dominion Experimental Farms and by most agricultural stations in Canada in both the East and the West.

Pending the development of better equipment and methods, the Associate Committee on Grain Research is providing an interim service of malting tests for these investigations. The staff of the malting laboratory at the University of Manitoba has been increased from one to four, standard equipment for the analysis of malts has been installed, improvements have been made in the malting method, and the work of the laboratory has been reorganized to provide malting tests for 550 samples of barley per year. The malting equipment designed and installed in 1927 by Professor T. J. Harrison is still being used. After doing yeoman service for nearly ten years it is now getting old and the test is losing its precision. Minor improvements are being made in the equipment from time to time but it seems probable that it will soon be necessary to install an entirely new malting plant.

THE SPECIAL BARLEY COMMITTEE

H. R. HARE [1]
Agricultural Economics Branch, Ottawa

On March 1, 1935, the Deputy Minister of the Department of Agriculture, Ottawa, named a Special Barley Committee to study certain phases of the barley problem. Their instructions were to probe the question more especially from the standpoint of transportation, storage, distribution and such other factors as were of importance with a view to determining what might be done to extend the domestic outlet for feed grains produced in Western Canada and to establish a more economical distribution of feed supplies to farmers in Eastern Canada and in British Columbia. The personnel of the committee was made up of officials of the Dominion Department of Agriculture. The secretary of the committee gave practically full time to the study during its progress.

A survey was conducted by means of statistical study, questionnaires, and personal and field investigations. Conditions and trends relative to cereal feed production and domestic utilization were studied by means of statistics which were assembled as follows:

(a) Production and interprovincial movement of western feed cereals.

(b) Production and interprovincial movement of hogs and bacon.

(c) Data concerning transportation rates.

Two questionnaires were circulated, one addressed to Dominion and Provincial agricultural officials throughout Canada, relative to the feed distribution system, and the other to the grain elevator operators of Eastern Canada, with a purpose of learning the facilities and charges for cleaning, grinding and handling feed cereals at the several points.

Members of the committee made personal and field investigations and visited a number of elevators along the Great Lakes and the St. Lawrence River.

Provincial Department of Agriculture officials were interviewed, and a brief study was also made of the co-operative feed distribution system in New York State, where the Grange League Federation operates with success. Opportunity was provided for committee members to meet and discuss the problem with members of the private grain trade, the western pools, feed distributors, nutrition research workers, millers and farmers throughout Canada. The results of the researches of this Committee might be summarized as follows.

Barley production in Canada is irregular and has varied during the past five years by above 70 million bushels. With other outlets relatively small and inelastic, domestic feeding operations have been adjusted to meet these wide variations in seasonal supplies. Carryovers on farms or in storage tend to level out these variations but have also created distress barley prices. The tendency has been to feed during the crop year a large percentage of any season's production, and the proven capacity of Canadian live stock feeders to absorb large volumes when available encourages

[1] Assistant Economist.

confidence that an increased amount over that used during the past three seasons could be used and, with suggested improvement, would be used to greater economic advantage.

Developments of the past few years suggest the wisdom of providing encouragement in the use of barley as feed at or near its point of production, improving the quality and exerting efforts toward leveling out the annual variation of yield. Yields of barley have been such during the past three years that no serious marketing problem has developed.

A greater outlet for barley or other cereal as feed may be achieved by its use to improve the finish of market animals or to feed an increased number of live stock on farms. The former offers a very definite and extensive opportunity. Some communities may well increase the number of certain classes of live stock, but apart from hogs for which there appears to be a broader market outlook, a general numerical increase is not widely favoured.

A study of the feed distribution system throughout Canada shows that the services are fairly satisfactory and the cost of services are generally moderate. There is evidence, however, to show that too frequently feed distributors stock and sell, and farmers buy, cheap rather than efficient feeds. The lack of knowledge of nutrition on the part of feed distributors and farmers and the failure of farmers to apply good live stock management practice appear to be great handicaps to profitable live stock feeding. Provincial Feed Boards are providing valuable leadership in this connection.

Imports of corn have been substantially reduced since 1930. The popularity of corn with poultrymen in particular, and also the relative advantage which, due to transportation costs, corn enjoys over barley at ocean coastal points, give little encouragement to anticipate further substantial reductions in feed corn consumption.

Officials and farmers in Eastern Canada object to the fine weed seed content of western grain to a degree which curtails its use as feed. Equipment is in position at Lake-head elevators to remove these seeds which are of little or of adverse value and which restrict trade in western grain; it appears economical, therefore, that they be removed before costs are incurred in their transport.

Rail transportation costs on feed moving from the Head-of-the-Lakes to Eastern Canada and local freight rates were reduced in April, 1935. These reductions though applied for one year only were sufficiently substantial as to dispel hopefulness of greater rate reductions in the near future. No reductions were extended to west-bound grain from the Prairie Provinces at that time and it is felt that the comparatively high rates which now prevail and which strongly discriminate against domestic as compared with export movement militate against the use of Prairie grown grain in that feed deficient Province of British Columbia.

Co-operative feed distribution is a success in many small and a few extended areas in Canada. Where local conditions favourable to co-operative effort prevail, activities might be extended to advantage. Under present conditions, its general field of activity is not likely to be greatly broadened.

A REVIEW OF PROGRESS MADE IN BARLEY PRODUCTION

P. C. WATT [1]
United Grain Growers Limited, Winnipeg, Manitoba

Barley presents an interesting example of what can be accomplished when science and commerce are properly co-ordinated, and when farmers co-operate, as they have done, by putting these findings to use in a practical way. It is unnecessary here to dwell on the importance of the part played by the farmer in achieving such results, as it is a prerequisite to the success of any work of this kind that the farmers demonstrate the practical results in the course of their regular farming operations.

Credit must be given to the National Barley Committee and those directing its activities for co-ordinating the work of these two great agencies, science and commerce, and for the results obtained during the short period of its existence, a matter of only a few years. The last general meeting of the National Committee, held in Toronto in March 1936, was productive of a great amount of good, and it was apparent to all those present that keen interest is being taken in all parts of Canada toward making some contributuion to our wheat problem by improving the production and marketing of barley, so that old markets may be retained and new markets found and thus enable us to increase our barley acreage. The spade work that has been done by those agencies all over Canada, forming the National Barley Committee, is a tribute to the efforts of those who have interested themselves in this work, and an indication of what can be accomplished in a short period of time when all the efforts being put forth are properly centralized.

At the time of writing, the 1936 barley crop has been pouring into the market for a matter of a few weeks only, but in that short period approximately eight million bushels have been inspected in the Western Inspection Division (about half of last year's total inspection), and it has become apparent from the records of inspected grades, that substantial strides have been made in improving our barley. To illustrate this point, it is of interest to examine the records of the Western Grain Inspection Department to see how they reflect the progress that is being made. The records of the past six crop years have been examined, and the percentage of the inspected barley which graded higher than 3 C.W. is as follows:

1930-31	8 %	1934-35	35 %
1931-32	17½%	1935-36	32 %
1932-33	30 %	1936-37	68 %
1933-34	29 %	(Aug. 1st to Sept. 17th).	

We find, therefore, that during the first seven weeks of the season 1936-37, over 5,000 cars of barley were inspected, and of these 68% graded higher than 3 C.W. As will be seen, this is a very substantial improvement over former years, and one is justified in believing that the cumulative results of the work done by scientific and commercial agencies is

[1] Manager, Terminal Elevators.

bearing fruit in a considerable way. It should be stated that the above percentages in one or two of the past five years might have been a little higher had it not been that some barley, although good malting barley in other respects, was graded 3 C.W. or lower because of the presence of frost. But making allowances for this, it still appears that very substantial progress has been made this season.

There are those who believe that the extremely high temperature prevailing during the growing season of the past summer was a contributing factor in producing the high quality—if not the quantity—in this year's barley. The main reasons however, are to be found in an examination of the barley itself. Better and purer seed has been used, greater care in threshing is apparent, and the barley has been sown on cleaner land. These are among the most important factors in producing barley of good quality. Work of this kind must necessarily take a few years to show results. Progress can seldom be represented by a straight line—it comes in spurts—and while considerable progress had already been made, it is apparent from this year's record to date that further substantial improvements have been made.

It is true that high prices have attracted barley growers, and their best barley has no doubt been marketed first to take advantage of high premiums being paid for malting grades, and because of this the 68% quoted above as being the percentage of barley so far this season grading higher than 3 C.W. may not be maintained throughout the year. Nevertheless, it is probably safe to state that by the end of this season the percentage will not have dropped below 55%, and may even be as high as 60%.

The money value to the farmer, as a result of this general improvement in the quality of our barley is a considerable item. If premiums for malting barley are maintained throughout the balance of the season at anywhere near levels prevailing during the early part of the barley movement it is safe to estimate that the improved quality will mean as much as a million dollars to barley growers. This computation is not an attempt to show the increased money value of this year's malting barley crop over last year's; as a matter of fact it will be very much greater, probably several million dollars. It is rather an attempt to illustrate that, other things being equal, the value of the improvement in the grades alone this year over last year is probably worth that much.

Although the percentage of barley so far this season grading higher than 3 C.W. is gratifying, there is no good reason why even a larger percentage of our barley than this could not be graded into the higher malting grades, but the figures already quoted indicate quite clearly the definite tendency to grow a better type of barley which, while making a satisfactory feed, can also command a good price as barley when it is put into commercial channels. In this connection it is interesting to examine into the reasons why some of the barley shipped this season failed to be graded higher than 3 C.W. A survey of the samples submitted this season to United Grain Growers Limited will illustrate this point with a fair degree of accuracy. This survey shows that about a thousand samples of barley have, during

the first few weeks of the season, been submitted either as newly threshed barley, the samples being sent in by farmers or country agents, or samples taken from cars at the time of inspection. These samples practically all came from 150 stations in Manitoba and Saskatchewan which are north of a line from Winnipeg to Oakville to Brandon and north-west to Saskatoon and Prince Albert. This covers a very large barley growing area.

The percentage of these samples graded as better than 3 C.W. barley bears out the record of the Inspection Department of this season, about 70% of them being graded into the higher grades. It was found that nearly a hundred, or, 10% of the samples submitted were Trebi barley, and because this barley does not qualify for the malting grades, they were necessarily graded as 3 C.W. or lower. The same applies to smooth awn varieties of which there were seventeen samples, all of which graded 3 C.W. or lower. About thirty of the samples submitted had an excess of wild oats, the percentage being higher than that allowed for the malting grades. Sixteen samples missed the malting grades because of their being a mixture of two-rowed and six-rowed varieties. Seventeen samples showed an excessive amount of smut, and these, it might be stated, all came from a few points mostly in the Portage plains. A matter of a dozen samples contained an excessive percentage of wheat too high to be permitted into the malting grades, and about fifty samples were of mixed varieties. The most important observation made, however, was that fifty-seven samples which had all the other qualifications for the malting grades, had to be graded as 3 C.W. or lower because of an excessive percentage of broken and peeled kernels. In this case we find that most of the samples came from a few stations, and it is quite apparent that a few threshermen can do a lot of damage and incur considerable loss, which is seemingly quite unnecessary to the growers of good malting barley.

The views expressed here may appear to be stressing the desirability of farmers growing malting barley, but that is not the intention. It is intended rather to stress the advantages of sowing pure seed of whatever variety will show the greatest return so that if the barley is to be shipped to market, it may command the highest possible price, even although premiums for malting grades may not always be as high as they have been this season and as they were two years ago. It is not intended by any means to suggest that barley be grown on land that is not suited to it.

The substantial premiums that prevailed in our market two years ago and again this year are entirely due to a demand from the United States brought about by short crops in that country. There is no good reason to anticipate a continuance of such premiums in seasons when the United States are amply supplied from their own country, as the normal Canadian and overseas demand creates only nominal premiums. But it occurs to the writer that the improvements which have been made in the quality of our barley, coupled with the changes which are likely to be made in the grading, and regulations to be established calling for cleaner barley to be shipped into export channels, will do more to enlarge the markets for Canadian barley than any high powered sales agency could possibly do.

BARLEY PRODUCTION IN CANADA

THE PLACE OF BARLEY IN CANADIAN AGRICULTURE

P. F. BREDT [1]
Manitoba Pool Elevators Limited, Winnipeg, Manitoba

Canadian agriculture, particularly Western Canadian agriculture, has been built up by and around wheat, which will unquestionably continue to be Western Canada's chief cash crop. It should be realized, however, that there must be a proper balance between wheat production and other branches of agriculture, for agriculture is not a single line activity, but a system of inter-related industries. A shrinking world market for wheat, the possible re-accumulation of large stocks of unwanted wheat in principal exporting countries, and a relative scarcity of other grains, present a field of constructive action in restoring a proper balance between the production of wheat and other cereals in Canada. It may safely be said that there appear to be greater possibilities for enlarging the market for Canadian barley than for any other of our coarse grains. This is possible of accomplishment by improving its quality and meeting the requirements of the buyer. Although barley comes third only in acreage, total yield, and value of our Canadian crops, it even now fills an important place in our agriculture.

Barley has been grown in Eastern Canada for over three hundred years, and for more than one hundred years in the West. The annual average barley acreage in Canada is approximately three and three quarter million acres, about three million acres being grown in the Prairie Provinces. The development of barley growing may be traced through two major periods of expansion since 1910. In the first period during the war, from 1914 to 1918, barley acreage doubled. After a moderate recession, another period of expansion commenced in 1920, and again barley acreage was doubled, reaching a high point in 1929 of 5,926,000 acres compared with about 2,552,000 in 1920. From this high point reached in 1929, barley acreage decreased by about two million acres in the next few years, with a corresponding decrease in yield. During the late disastrous growing seasons, rust, grasshoppers, and drought have further lowered the barley yield. The peak of production occurred during the three-year period, 1928 to 1930. In 1928, over 136,000,000 bushels were produced, compared with a yearly production from 1931 to date varying between 67,000,000 and 83,000,000 bushels. With such a drastic reduction in yield, it is only natural that our exports of barley are tremendously reduced compared to high production years. While Canada exported 40,000,000 bushels in 1928-29, the total export during the last six crop years has amounted to only 57,000,000 bushels. At the same time our annual carryover has gone down from 29,000,000 in 1930-31, to 5,500,000 bushels in 1935-36.

The popularity of barley as a field crop in many areas of the Prairie Provinces lies in the fact that it fits in admirably in a plan of crop rotation.

[1] President.

Barley is an early maturing cereal, and therefore makes an excellent cleaning crop and can be used to eradicate wild oats and other noxious weeds. It may be sown late in the spring, giving an opportunity to kill weeds which have already started, and will yield fairly well on land which would not return a satisfactory crop of wheat or oats. The general tendency has been, and to some extent will likely continue to be, to produce barley on the poorest and most weed infested land, with the result that the quality is likely to be poor and the weed seed content high.

During the last few years, a great deal has been done by the departments of agriculture, universities, and other interested organizations to improve the quality of our barley. This work, which has been carried on in many cases under the auspices of the National Barley Committee, has already borne fruit, and with a return to more normal crop seasons, the results will show that these activities have been well worth while. It must be kept in mind, however, that due to limited supplies, premiums on good type barleys suitable for malting have been higher in the last few years than could be expected under normal conditions.

Barley acreage, particularly in those sections of the West which produce the desired type, should be increased. Very often it is in these very sections that the wheat produced is of low protein content, which is undesirable in this cereal but desirable in malting barley. As barley acreage expands, and supplies much in excess of domestic malting requirements are produced, Western farmers would most certainly receive only a small premium on their high quality barley unless considerable quantities could be marketed overseas. It is therefore of great importance to endeavor to locate such a market and ascertain its requirements. Failing this, severe criticism against increased production would be justified, and it would also result in a tremendous setback to the efforts now under way to improve the general quality of our barley.

As previously stated, barley now ranks third in value of production of Canadian grain. It is possible to increase its importance tremendously because it has a variety and multiplicity of uses greater than any other cereal crop. It is the opinion of the writer that we should have some definite objectives in view to promote the production of barley, improve its quality, and at the same time endeavor to provide markets which will return to the grower a fair return for his labor. These objectives should be:

1. To build up adequate reserves of barley as a feed grain on our farms.
2. To supply sufficient barley to meet the full requirements of the live stock feeder, both in the West and in Eastern Canada.
3. To develop an export market for feed barley; and in respect to malting barley, after our domestic trade is supplied, pay special attention to the distilling and malting trade overseas, particularly in the United Kingdom.

The attainment of the first objective—to build up adequate reserves of feed grains on our farms—will be readily endorsed by all.

As to the second objective—to produce sufficient barley to meet all our feed requirements, both in the East and West—objection may be taken

by some that this would be "Economic nationalism" directed against the importation of foreign corn. A certain quantity of corn will always be imported, more in deficiency years, particularly into those sections near ocean ports. On the other hand, it would obviously be in our national interest to have more barley fed to hogs intended for export, as it is recognized that barley insures the production of high quality bacon, and it is to the bacon market of Great Britain we will have to look to absorb increasing quantities of our hog production. More barley is used for live stock in Canada than for all other purposes. It has been proven that barley produces a whiter, firmer, and better flavored bacon than other feeds. Feeding experiments in poultry have shown barley to be equal to most other grains, and that it should constitute at least part of the grain ration. It has also been demonstrated that barley makes an excellent feed for fattening beef animals, and mixed with oats provides a suitable ration for horses.

Since undoubtedly barley will continue to be used to a great extent as a cleaning crop and as a feed for livestock, our best market for barley should be the "hoof" market. An increasing demand for our live stock, at living prices to the farmer, would be a greater stimulus to barley production than the expansion of our export market. It does not matter so much to the farmer who feeds all the barley he grows to his live stock, what the market price of the barley is. What is important to him is the price he gets for his barley on the "hoof".

It has been the hope of Western Canada that ways and means would be found whereby surplus barley and other feed grains from the Prairie Provinces could be utilized by the live stock industry of Eastern Canada, to the mutual advantage of East and West. Substantial progress was made some years ago, but shortage of supplies in the last few years has naturally retarded these efforts. Domestic freight rates makes the cost of forwarding Western feeds to the live stock feeders of Eastern Canada relatively high, and while there has been some improvement in the freight rate structure, the matter of distribution to feeders in the East who buy their supplies in relatively small quantities, still presents a problem.

The objection which Eastern feeders have always had against our feed barleys—high weed seed content—will likely be corrected with the coming into effect of new barley grades, possibly next season. These will specify that even the feed barley grades must be practically free from the small black seeds, which, it has been proven by experiment, are not only useless but even injurious in some cases. This should prove to be added incentive, when sufficient supplies are available, for Eastern feeders to use Western barley rather than corn.

In regard to the third objective—development of the export market for feed barley—this of course must be based on our ability to meet competitive prices of other barleys and corn overseas. How successful our efforts will be along this line will depend to a great extent upon live stock production overseas and on our ability to reduce production costs.

If the production of high-class barleys suitable for malting is in excess of domestic requirements, there is a small export market for barleys of this

type in the distilling and malt extract trade in the United Kingdom. As we are better able to meet the requirements of this market, it should gradually and steadily expand. It is not to be expected, however, that premiums which may be available in this market will be on the same basis as those which, due to shortage of supplies and demand from the United States market, have been ruling in the West during the last few years. Price and premiums of course are a much more serious matter to the farmer who grows barley as a cash crop. The size of the premium may make all the difference between profit and loss on the year's operations for the farmer who seeds the best type of malting barley he can procure, on well summer-fallowed land, and who takes particular pains in harvesting and threshing his barley.

The malting companies in Canada have done splendid work in assisting to improve the quality of the product they use in their operations, and have paid substantial premiums for that quality. They cannot be expected, however, to continue to pay these high premiums if there is considerably more barley produced than they require; hence the necessity for further markets being secured abroad for the surplus which is not needed at home.

So that barley may occupy the place in Canadian agriculture which it rightfully deserves, a great deal of research work must be done in order to achieve the desired end. This would involve—on the production side—the breeding and selection of suitable varieties, the zoning of areas best adapted to certain types of barley, and the study of barley disease and breeding of disease resistant varieties. On the marketing side it would mean the further study of the requirements of the domestic and overseas market, both for feeding and the malting and distilling trade. Given the continued close co-operation which now exists between the Dominion Department of Agriculture, the Department of Trade and Commerce, the Provincial Departments of Agriculture, and all the institutions and agencies which are now linked together in the National Barley Committee, and above all provided a price is obtainable which will insure a reasonable return to the producer, a re-adjustment can be made which will give barley its proper place in our agricultural industry.

VARIETIES OF BARLEY GROWN IN CANADA

P. R. Cowan [1]

Cereal Division, Central Experimental Farm, Ottawa

Of the cereal crops grown in Canada, the most inadequately described and the hardest to identify is barley. There are two reasons for this state of affairs; one is that the differences between the various types are so obvious that description of them is almost superfluous, and, on the other hand, our cultivated varieties are so closely related that differences between them are difficult to find, with the result that most persons have fought shy of making descriptions. The descriptions here given do not pretend to be all-inclusive, but are merely popular descriptions so that one may know the more common characteristics of the varieties most commonly grown.

In order to understand the descriptions, it will be necessary to define in some detail the terms used. The normal head of barley has three spikelets at each joint on the head (the rachis) so that when a head is examined it appears to possess six rows of grain. The two-rowed varieties possess the same number of spikelets at each joint, two of which are not fertile; thus the head has only one kernel on each side making the head appear to be two-rowed. Under field conditions, the kernels of a six-rowed variety are somewhat twisted because the three grains which grow from the one single point on the head, in their endeavour to grow upright, cause the outer ones to become twisted; whereas, the two-rowed varieties, with only the one grain at a joint, grow straight upright. The kernels from two-rowed barleys are all straight and symetrical, while those from six-rowed barleys are one-third straight and symetrical (the central kernels) and two-thirds twisted and not symetrical (the laterals); in other words, a sample of barley with the kernels all straight is two-rowed, and a sample with the kernels twisted and non-symetrical is six-rowed.

The skin under the hull is quite an important character to observe. The aleurone, as we call this, may be either blue or yellow. It is not always possible to tell this colour, especially in an immature sample, as this colour is the last part of the grain to be laid down during the process of maturity. In the average sample, there is usually enough indication to be able to say whether the sample is blue or yellow, but probably not enough to say if it be pure.

The beards or awns of barley may be of two kinds, those that are rough and those that are smooth, or practically smooth. The roughening of the awn is caused by minute barbs on the sides. The relative length of these awns is a character that may be of value in a final analysis. Some varieties have awns of practically the same length on both the central and lateral spikelets of a six-rowed variety, while in others the lateral awns are shorter than the centrals. The size of the kernels, whether centrals or laterals, will vary in somewhat the same way as do the awns, the laterals being either smaller or of practically the same size as the centrals.

[1] Cereal Specialist, Barley Investigations.

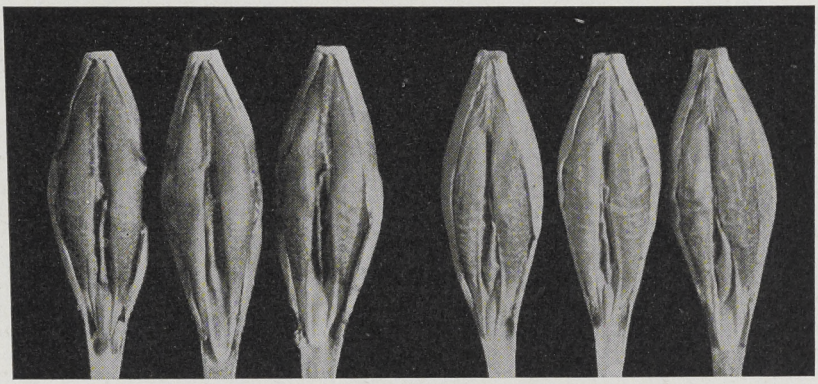


FIGURE 1.—*Grains of barley showing long haired rachilla (on left) and short haired rachilla (on right). Magnified three times.*

FIGURE 2

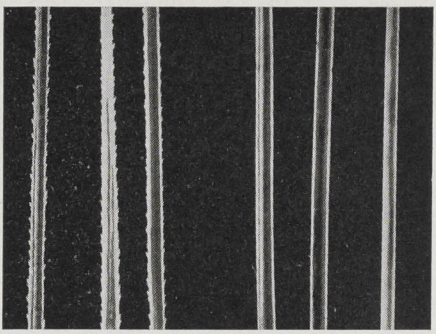


FIGURE 3

FIGURE 2.—*Rachillae of barley greatly magnified. Long haired on left and short haired on right.*
FIGURE 3.—*Barley awns magnified four times. Rough awns on left, smooth awns on right.*

More difficult to see, but an important character to observe, is the hairiness of the rachilla. On the crease side of the kernel at the base end will be found a small hairy appendage, the rachilla. The rachillae are usually short haired or long haired.

On the other side of the kernel, the side away from the crease, will be noticed a number of veins running the length of the kernel, usually five in number; on these veins and between them at the awn end will be found minute barbs, the presence or absence of which is quite characteristic of the different varieties.

Laxity or denseness of head, that is the number of spikelets to the inch, is important and is used for grouping the two-rowed varieties. The more spikelets to the inch, the more compact will be the head. The Thorpe barleys are compact while the Chevaliers are lax.

These characters, when kept in mind, will help greatly to follow the descriptions given below.

O.A.C. 21:—This is a six-rowed variety with rough awns. The plant is medium to tall with leaves of medium width and medium green in colour. The heads are well protruded from the leaf sheath extending usually from four to six inches. The heads are quite nodding and, in some cases, completely bent over so as to lie parallel with the stem, awns down. The awns are covered with numerous medium fine barbs, the awns on the central spikelets being

longer than those on the laterals. The kernels are of medium size, the lateral kernels being smaller than the central kernels. The aleurone is blue, the rachilla hairs short, and the barbs on the veins of the kernels numerous.

Mensury:—The description given for O.A.C. 21 is applicable to Mensury except that the heads are not so nodding and the straw is slightly stronger.

Manchurian:—This is a six-rowed variety with rough awns. The plant is medium to tall with leaves of medium width and medium colour. The heads are well protruded usually from four to six inches. The heads are nodding. The awns are covered with numerous medium fine barbs. The awns are longer on the central spikelets than on the laterals. The kernels are of medium size, the lateral kernels being smaller than the centrals. The aleurone is yellow and, in this respect, differs from O.A.C. 21 and Mensury. The rachilla hairs are short and the barbs on the veins of the kernels are numerous.

Peatland:—In general this variety conforms to the description given for Manchurian except that the straw is stronger and this variety has resistance to stem rust, the heads are not quite as nodding, and the kernel veins are slightly more barbed. The kernels of both are yellow and possess short haired rachillae.

Trebi:—This is a six-rowed variety with very rough coarse awns. The plant is medium to short with leaves of medium width but darker green than any of the above. The heads are more upright and partially enclosed in the leaf sheath. The awns are coarse and covered with a medium number of coarse barbs. The awns on the lateral spikelets are practically the same length as those on the centrals. The kernels are longer, larger and more pointed than any of the above, with the lateral kernels being approximately the same size as the centrals. The aleurone is blue, the rachilla hairs short and the veins on the kernels have no or only very few barbs on them.

Olli:—This is one of the earliest maturing varieties grown in Canada and is six-rowed and rough awned. The plant is of medium height with leaves of medium width and colour. The heads are protruded from the leaf sheath usually from three to five inches, and only slightly nodding. The awns are covered with numerous medium fine barbs. The awns on the lateral spikelets are only slightly shorter than those on the centrals. The kernels are of good size, the laterals being approximately the same size as the centrals. The aleurone is blue, the rachilla hairs are short and the barbs on the veins of the kernels none or very few. The veins are often quite coloured before the heads are completely mature.

Velvet:—This is six-rowed and smooth awned. The plant is medium to tall in height with leaves of medium width and colour. The heads are only slightly protruding, rarely over three inches. The heads are quite nodding. The awns are smooth, there being no barbs on the awns except at the tip, about one-quarter of the awn having very fine barbs. The awns on the central spikelets are longer than those on the laterals; the central kernels are somewhat larger than the lateral kernels. The aleurone is yellow, the rachilla hairs are long, the barbs on the veins are few and the hairs on the outer glumes are few.

Regal:—This is six-rowed and smooth awned. The plant is medium to medium short in height with leaves that are of medium width and lighter green than Velvet. The heads protrude only slightly, rarely over three inches. The heads are nodding. The awns are smooth, about one third of the awn having very fine barbs. The awns on the central spikelets are only slightly longer than those on the laterals; the central kernels are slightly larger than the lateral kernels. The aleurone is yellow, the rachilla hairs are long, the barbs on the veins are few and the hairs on the outer glumes are few.

Wisconsin Pedigree:—This is six-rowed and smooth awned. The plant is medium to tall, leaves of medium width and somewhat darker than Regal. The heads are quite lax and longer than the other smooth-awned varieties and held fairly upright, the head itself bending over rather than nodding. The heads, while not enclosed, do not completely protrude from the sheath. The awns are smooth to about one-third from the tip where the barbs are very fine. The awns on the central spikelets are longer than those on the laterals. The central kernels are larger than the laterals. The aleurone is yellow, the rachilla hairs are long, only very few barbs on the veins and a very few hairs on the outer glumes.

Nobarb:—This variety is six-rowed and smooth awned. The plant is medium in height with leaves of medium width and colour. The heads are only slightly protruded rarely over two inches and held almost upright. The awns are smooth to about one fifth from the tip where the barbs are fine. Nobarb is the smoothest of the smooth awned varieties. The awns on the central spikelets are longer than on the laterals. The central kernels are also slightly larger than the laterals. The aleurone is yellow, the rachilla hairs are short, no or very few barbs on the veins and a medium number of hairs on the outer glumes.

Newal:—This is six-rowed and smooth awned. The plant is medium in height with leaves of medium width and dark green. The heads are only slightly protruded from the sheath,

being often partly enclosed. The awns are smooth to about one-third from the tip where the barbs are very fine. The awns on the central spikelets are longer than those on the laterals. The aleurone is yellow, the rachilla hairs are long, few barbs on the veins and the outer glumes are covered with numerous hairs.

Hannchen:—This is two-rowed and rough awned. The plant is medium to short in height with leaves that are narrow and dark green. The heads are narrow and of medium density and do not protrude from the leaf sheath and are held upright. The awns are rough, covered with numerous medium fine barbs. The aleurone is yellow, the rachilla hairs long and there are no barbs on the veins. The sterile spikelets are large.

Canadian Thorpe:—This is a two-rowed Thorpe type barley, that is a barley with a compact wide head, the awns are rough. The plant is medium in height with medium to narrow leaves that are medium to dark in colour. The heads are completely protruded from the leaf sheath from two to four inches and are slightly nodding. The awns are covered with medium barbs. The aleurone is yellow, the rachilla hairs are long, the barbs on the veins are very few and the sterile spikelets are large.

Charlottetown 80:—This is a two-rowed Chevalier type of barley, that is, the heads are lax and narrow, the awns are rough. The plant is medium to tall with medium narrow leaves of medium colour. The heads completely protrude about four inches from the sheath and are nodding. The awns are covered with medium barbs. The aleurone is yellow, the rachilla hairs are short, the veins are medium barbed and the sterile spikelets are large.

Sanalta:—This is a Thorpe type smooth awned barley. The plant is medium to tall with medium narrow leaves that are medium to dark green. The heads, which are wide and compact, are well protruded and held upright. The awns are smooth to about one-quarter from the tip. The aleurone is yellow, the rachilla hairs are long, no barbs on the veins, the sterile spikelets are large and the outer glumes are medium haired.

BARLEY

Key to Varieties Grown in Canada.

- Six-Rowed
  - Awns Rough
    - Aleurone Blue
      - Rachilla Hairs short
        - Veins with numerous barbs: O.A.C. 21; Mensury Ott.60
        - Veins with few or no barbs: Trebi; Olli
    - Aleurone yellow
      - Rachilla Hairs short
        - Veins with numerous barbs: Manchurian; Peatland
  - Awns Smooth
    - Aleurone yellow
      - Rachilla Hairs long
        - Veins with few barbs: Velvet; Regal
        - Veins with no barbs: Newal; Wis. Ped. 38
      - Rachilla Hairs short
        - Veins with few or no barbs: Nobarb
- Two-Rowed
  - Awns Rough
    - Aleurone yellow
      - Rachilla Hairs long
        - Veins with few barbs: Can. Thorpe
        - Veins with no barbs: Hannchen
      - Rachilla Hairs short
        - Veins with medium number of barbs: Charlottetown 80
  - Awns smooth
    - Aleurone yellow
      - Rachilla Hairs long
        - Veins with no barbs: Sannalta

MALTING BARLEY IMPROVEMENT

PETER STEWART[1]
Canada Malting Co., Limited, Toronto, Ontario

In the latter part of the nineteenth century Canada was doing a thriving export trade in malting barley. Exports to United States averaged about 10,000,000 bushels for a period of several years. This barley was largely grown along the shore of Lake Ontario, in the territory between Toronto and Kingston. When this trade was obliterated by the imposition of the McKinley tariff in 1890, barley growers of Ontario turned to live stock and dairying, and commenced to grow their grains in mixtures for feeding purposes. This situation was further intensified by the advent of the prohibition era in Canada, which became general in the second year of the Great War, with the result that the growing of high class barley in Ontario became a lost art.

During this same period, which covers roughly the years 1880 to 1916, grain production had been progressing by leaps and bounds in Western Canada. But in this historic development, wheat was the goal of every settler. Oats were also given some attention, but barley found a place principally as a sort of scavenger crop, to be resorted to only when fertility showed signs of depletion, and weeds commenced to get the upper hand. Under such circumstances no attention whatever was paid to the factor of quality in barley. It was usually sown late on dirty land that had received little or no preparation. If it failed to grow under such conditions the land was summer-fallowed. If it grew to maturity, it received about the same relative consideration at harvest as at seedtime. Under such conditions it naturally followed that only an insignificant proportion of the total barley crop of Western Canada could qualify for a classification higher than feed.

This was the barley situation in both Eastern and Western Canada as recently as thirteen years ago, and the problem of effecting a practical improvement in part of the crop within a reasonable time seemed worthy of some serious attention. Quite apart from export possibilities, there was a steady domestic market for over 5,000,000 bushels of good barley for malting purposes. Hence it was perhaps logical that the initiative in a campaign for barley improvement should come from the largest domestic purchasers of good barley.

After consulting plant breeders and research workers in agronomy of the various agricultural colleges, departments of agriculture and experimental farms, it was decided to endeavour to determine which of the varieties of barley were best suited for malting purposes, and with this in view Canada Malting Company in 1924 undertook the testing, for malting quality, of innumerable samples representing all known varieties of barley as grown in many localities throughout Canada. The results of these tests were published annually for four years. During this time, and ever since then, the laboratories and plants of the Company were thrown open to

[1] Barley Specialist.

these scientific and extension workers, and Company officials met them at every opportunity in order to discuss barley problems of a national character.

Having determined that the O.A.C. 21 variety was the most attractive from a malting standpoint, steps were taken to build up a supply of pure seed of this variety. This was accomplished in various ways over a period of about five years from 1924 to 1928, during which time stocks of registered seed barley sealed in the sack in Canada were increased from 1,865 bushels to 17,781 bushels, and the acreage of barley producing registered crops increased from 372 acres in 1923 to 3,121 acres in 1929.

This very substantial development was accomplished by bonusing certain units of registered seed growers in favoured localities, and by purchasing their surplus seed and placing it for reproduction on contract in territories where required, and in turn taking the multiplied product and selling it at cost or less for seed purposes in selected districts. In addition, individual growers of registered seed barley were encouraged by special contract arrangements whereby a substantial premium was guaranteed at seeding time for their crops of the same year. Lots of registered seed secured in this manner were also multiplied on contract, and the resulting product redistributed as No. 1 commercial seed. This programme soon grew to the point where single plants of the Company were distributing as much as 50,000 bushels each spring of No. 1 Commercial O.A.C. 21 seed barley grown from registered seed.

Concurrently with its policy of multiplying and distributing pure seed barley of a suitable variety, the Company used the agricultural press freely; met farmers and groups of farmers wherever and whenever possible in suitable districts to discuss barley as a cash crop; published, and distributed widely practical booklets on the subject; donated cash prizes and trophies for barley at all the important seed exhibitions in Canada and the International Hay and Grain Show in Chicago; in general, overlooked no opportunity of lending a hand to raise the status of Canadian barley at home and abroad. And so it was that in the space of six short years, and in somewhat the manner outlined, was launched what may be termed by future historians of Empire "The Canadian Barley Renaissance". Playing their parts well and truly in this national epic of agricultural progress were to be found the colleges and departments of agriculture of five provinces; the Dominion Seed Branch and Dominion Experimental Farms; the grain and seed trades of Canada; many agricultural societies; the agricultural press; the Canadian Seed Growers' Association, and others.

In later years, operating as a member of The National Barley Committee, the policy of good seed distribution each spring has been continued. This year the Company handled about one quarter of all the registered seed barley which was available in Canada. About half of this, or 3,000 bushels, was distributed through dealers in selected districts in Eastern Canada, and the balance placed with farmers, free of charge, for reproduction on contract. In addition about 50,000 bushels of selected seed barley was distributed to farmers in both Eastern and Western Canada, at prices considerably below the market then prevailing. The plan of donating

awards for barley classes at seed and grain exhibitions has been curtailed somewhat, and this support has been replaced with a very active interest in the advancement of boys barley clubs, some fifty-one of which in the three Prairie Provinces are receiving assistance and encouragement at the present time. The Company has also identified itself in a financial way and otherwise with three plant breeding and field management projects in relation to barley, which are now being carried on under the auspices of agricultural colleges in Eastern and Western Canada. With a view to assisting barley growers in Western Canada toward improving their seed, without the outlay of cash, the Company co-operates with line elevator companies in classifying farmers' samples from a seed standpoint. In the past two years some 3,500 samples have been analyzed for this purpose, and the information passed back to the country for guidance of the interested parties. In addition to its private barley research programme, the Company has been very happy to affiliate itself with the National Research Council for the purpose of carrying on projects in barley and malting research.

In the conception and execution of all schemes for barley improvement, the welfare of the grower has always received and is receiving first consideration. For it is realized that unless the production of good barley as a cash crop can be made and kept a relatively attractive source of farm income, the whole plan of crop improvement must fail. That it has not failed is due in great measure to the unfailing support received at all times from the majority of consumers of barley malt in Canada.

THE EXPERIMENTAL MALTING OF BARLEY

G. P. McRostie [1]
University of Manitoba, Winnipeg, Man.

During 1932 and 1933, approximately 250 samples of barley were analysed in the malting laboratory at the University of Manitoba. During the year 1933 approximately 300 samples were put through the various laboratory tests. In order to have a somewhat better understanding of the labour involved in testing the suitability of barley for malting purposes, some of the tests that have to be carried out, either at the laboratory or before it reaches there are described.

Needless to say, all material must be very carefully planted and grown to ensure the fresh material being representative of the variety, the possibilities of the district, and the conditions under which it was grown. When one studies the reports on the co-operative tests being carried on throughout Canada, it is readily understood that the growing and harvesting of samples for malting purposes entails no small amount of labour.

[1] Formerly Professor of Field Husbandry at the University of Manitoba. Appointed Professor of Field Husbandry at the Ontario Agricultural College in December, 1936.

After the samples are carefully grown, harvested, and adequately sampled they are ready for the initial laboratory tests. These consist of securing:

1. Weight per bushel
2. Weight per 1,000 kernels
3. Germination
4. Nitrogen content.

At the present time the weight per 1,000 kernels and the percentage nitrogen are being determined for the most part by the station or institution sending in the sample.

When the various lots finally reach the laboratory they are re-sampled for malting purposes and then passed through the various stages of the malting process. This process consists, generally speaking, of steeping, germinating, and drying. The essential changes that take place in the barley kernels are the change of a material portion of the starch of the endosperm into sugar compounds, and the accumulation and activation of the enzymes which function in bringing about the changes just mentioned. When the germination and drying process is complete, the grain is then in the condition in which it is sold by the malting companies.

In the laboratory further tests are made to determine the amount of sugar that has been produced by each sample and also its ability to change further starch sources into sugar. The first of these processes is recorded as the percentage of extract obtained. This is determined by grinding the sample, mixing it with a definite quantity of distilled water and allowing it to digest for stated periods at predetermined temperatures. The liquid thus secured is filtered off and its sugar content determined by specific gravity. The second process, known as the diastatic value, is arrived at by placing a definite quantity of the ground malt in contact with a fixed amount of starch, placing the mixture under favourable conditions and determining the amount of starch that has been changed to sugar due to the activity of the enzymes contained in the sample of ground malt.

The amount of extract secured and the ability of the sample to react on sources of unchanged starch are the two main attributes of most importance in determining the relative value of barleys for malting purposes. Other factors which concern the appearance of the commercial malt have also to be taken into consideration.

So much for the malting process itself; the next consideration is the purpose of the malting tests now being conducted. The objects are several, among which are the following:

1. To determine the relative malting value of the different barleys now being grown in Canada and of the new productions being bred and introduced by the plant breeders.

2. To determine the areas of Canada best suited for the production of malting barley.

3. To determine within each of these areas the best malting variety for the area in question.

4. To ascertain the influence of various cultural practices on malting quality.

To date, there have been four general reports and a number of papers prepared giving the results secured. The reports have been mimeographed and are available to members of the National Committee.

In general, the findings may be summarized as follows:

1. Influence of Variety on Malting Quality.

In all of the tests a very definite and significant difference has been found to exist between varieties of barley. On the whole the results have borne out the desirability of the segregation with regard to malting barleys that now exists under the Canada Grain Act Regulations. Trebi, and its close relatives have consistently been unsatisfactory in their malting reactions. The smooth awned varieties have presented considerable variation. The Wisconsin No. 38 has been consistently the lowest of the smooth awned varieties under test in extract, and has usually produced a rather ragged product. New material under test indicates the possibility of securing at least a much more satisfactory smooth awned type than the Wisconsin No. 38 for malting purposes. At present the discrimination against these types on the part of the malting trade appears to have considerable justification with varieties available in commercial quantities.

While there appears to be a correlation between high protein and low extract in the instance of individual varieties, it does not follow that high protein barleys are poor malting ones. Peatland with its high protein and good malting quality is a case in point.

2. Influence of Location on Malting Quality.

It has been very definitely indicated by the results obtained that location plays an important part in determining the malting value of any variety. On the whole, the stations at which tests were made in Eastern Canada produced barleys with higher extract than similar varieties grown in Western Canada. The analyses of the 1935 crop year material will give much additional information in this connection because of the widespread nature of the tests. Even within smaller areas very noticeable differences occur; for example, O.A.C. No. 21 in the crop year of 1934 gave significantly higher extract at Fredericton, N.B., Nappan, N.S., and Charlottetown, P.E.I., than it did at Guelph, Ont. or Ottawa, Ont. In Western Canada the same variety gave very significantly higher extracts at Winnipeg or Brandon, Man., and Indian Head, Sask., than at Morden, Man., or Scott, Sask.

The variation in extract with variety and locality is not the only variable. A much wider variation occurs in diastase than in the extract, both with variety and location. Very significant differences also appear in the case of the percentage of protein.

3. Influence of Cultural Practices on Malting Quality.

This phase of the barley investigations has not yet progressed sufficiently far to draw any definite conclusions but the preliminary results bear out the fact that early planting, summer-fallow or second crop in the rotation, and judicious fertilization appear to produce the most satisfactory malting barley. A fairly wide range of rates of planting would seem to be possible without seriously interfering with either yield or malting quality.

THE PROCESSING AND USES OF BARLEY

BARLEY MALT—ITS MANUFACTURE AND USES

D. S. KAUFMAN [1]
Dominion Malting Company Limited, Winnipeg, Manitoba

It is believed that even in ancient times, as well as in the middle ages, barley, one of the oldest cultivated cereals, was used in a partially malted form by different nations for the preparation of various beverages. However, we shall not endeavour to go into the history of barley malt, but shall start from the time when malting of barley, in addition to being an art, also becomes a science.

The application of science to malting begins with the discovery of enzymes as catalytic agents, and especially with the discovery of the diastase enzyme by Payen and Persoz in 1833. These two men observed that an extract prepared from germinating barley was capable of converting starch into sugar. This was the most fundamental disclosure of the principle underlying the malting process, thus enabling the science of malting and brewing to reach its present state.

While the physiological and chemical processes that take place during the malting of barley were being explored and were rapidly progressing, the mechanical end remained more or less in a primitive state until the last quarter of the 19th century and the beginning of the 20th. Nicholas Galland of France in the 1880's developed the pneumatic malting system. This is the first mechanical discovery of any importance, taken from the standpoint of the controlling of temperatures and moistures during the malting process. Also about the same time the drying and curing of malt was improved and put under proper technical control.

Along with all these chemical and mechanical discoveries and improvements which helped put the the malting industry on a sound basis, the main material used in malting—barley—was not neglected. All over Europe studies of barley suitable for malting purposes were undertaken. On this continent special studies were undertaken in 1905 by Professor R. A. Moore of the Agricultural Experimental Station, Madison, Wisconsin, in collaboration with Robert Wahl. Their research culminated in the selection of the Oderbrucker barley, which, up to date is considered the best for malting in the United States. Oderbrucker is a selection of the Manchurian type which was first introduced to Canada and then to the United States.

A few years later the O.A.C. 21 was selected by Dr. Zavitz of the Ontario Agricultural College. This is a selection of the Manchurian type, and from every standpoint so far is still the best malting barley grown in Canada.

All the above factors helped the maltster to depend less on empirical methods, thus putting his business under technical control. To be up to date a malt-house not only has to be furnished with modern malting equip-

[1] Plant Superintendent.

ment, but must be staffed with technically trained men. It must also have a modern laboratory for the testing of all raw materials used as well as the resulting products.

The Manufacture of Malt

In manufacturing barley into malt the maltster endeavours to utilize the vitality of the barley grain to such an extent as to develop the necessary concentration of diastatic and proteolytic activity and, at the same time, modify the carbohydrates and proteins. This concentration of enzymes and modification of the barley content has to be made to suit the specific purpose for which it is to be used, i.e., whether the malt will be used for the brewing, distilling or extract trades. More than that, the particular type of brewing characteristic of the country has to be taken into consideration while malting the grain; in addition this is to be effected in the most economical way, without any unnecessary loss and consequent increase in the cost of production.

Since barley grain is the only material used in malting and this in turn has a great effect on the quality of the malt as well as on the cost of production, the maltster has to be extremely cautious in his selection of the grain. The most common type of barley used on this continent is the six-rowed barley, Manchurian type. This type of barley gives the most suitable malt for the brewing methods employed in this country, and is also quite suitable from the maltsters standpoint. From the standpoint of the brewer, barley to be suitable should be of the proper chemical composition, i.e., have the right nitrogen content and be rich in carbohydrates. This is necessary in order to obtain the desired amount of enzymatic activity as well as the desired amount of extract.

From the maltsters standpoint the barley has to be of good vitality giving an even and vigorous germinating power, as well as germinating capacity. Samples with less than 96% germination are not desirable. Barley, to possess the above mentioned properties must be fresh, sound, properly matured, plump, mellow, free from fungus diseases and physical injuries which might interfere with normal malting. Barley must not be steely or it will not modify properly. This is true, especially when steeliness is caused, not by improperly matured grain but by an excessively high nitrogen content. It must also be threshed properly in order not to be skinned, otherwise it is subject to mould and other bacterial infections.

At the present, when prices of malting barley, as compared with other cereals, are high, the question arises, "Why not malt wheat or rye?" Barley is superior to wheat or rye for use in producing malt because it contains less undesirable proteins, and because the endosperm is covered with a husk protecting the acrospire during the malting process. This same husk also serves as a filter material in the mash tun.

The malting process consists of four stages. The initial stage is the preparation of the grain in order to secure a cleaner and more uniform material. This is done by first cleaning the barley, and also by separating and grading it according to length and width. Sometimes when the moisture content in the barley is excessive it has to be dried or conditioned.

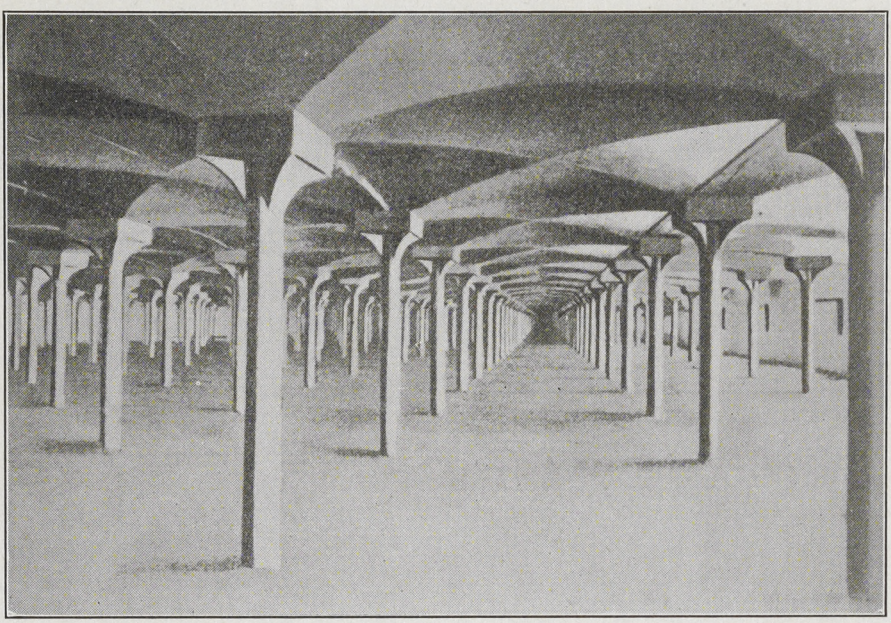


FIGURE 1.—*Germinating floor in a brewery in Dublin, Ireland, showing barley spread out to germinate.*

When the barley comes to the malting plant it always contains much dust, foreign seeds and injured kernels. The dust and foreign seeds must be removed so that there will be no growth of moulds and micro-organisms during the malting process, so that no foreign taste may be acquired by the malt. The barley must also be graded in order to make it as uniform in size as possible, so that it steeps properly; all broken and injured kernels must be removed.

The second stage in the malting process is steeping. This means the soaking of the barley in water until the desired amount of moisture is absorbed by the barley grain, and until this gives rise to certain physiological functions in the plant, causing subsequent germination. During the steeping process the barley is also washed and aerated. One of the aims of the steeping process is to dissolve the colouring matter from the hull and other extractive substances, which otherwise would give to the malt and beer a raw taste and dark colour. During the steeping the water is flooded off, air and fresh water are pumped into the steep tanks in order to clean and aerate the grain and cause the light kernels to float off into the overflow. The first water in the steeping is usually limed, thus minimizing the chance of infection from moulds or micro-organisms.

The third step in the malting process is the germinating stage. From the steep tanks the grain is conveyed to the germination department which may be an ordinary floor, compartment, or drum, depending on the malting system in use. It is in the germinating room that the main biochemical

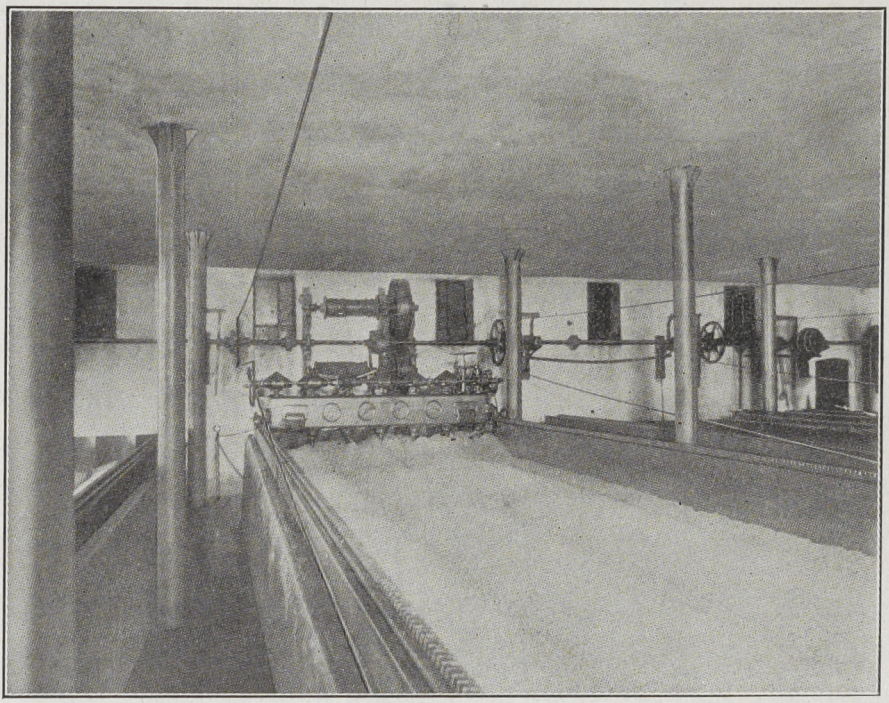


FIGURE 2.—*In the Saladin system, one of the two principal systems used in Canada, the barley is germinated in long bins or compartments.*

changes take place and where the content of the barley grain is modified and made into what is usually called malt. In the germinating room the temperatures are strictly controlled, the air, before coming into contact with the germinating barley, is properly conditioned so as to contain the right percentage of humidity and to have the right temperature. After modification is found to be complete, the growth of the malt is arrested by withering it and it is then conveyed to the kiln. During this process the grain germinates and produces small rootlets, and the acrospire grows to about the full length of the grain.

Kilning is the final step in the malting process. It consists of two stages, drying and curing. During the drying the temperature is gradually raised with an abundance of air. In curing the temperature is raised to the highest degree desired and kept for a certain time at this temperature. The kilns used on this continent are all equipped with fans and self-dumping devices. Fuel used under the kilns is the purest form of anthracite, free from arsenic. After the kilning is completed the malt is conveyed to storage bins where it is aged from two to three months, and cleaned prior to shipment. This cleaning means the removal of the tiny rootlets that were formed during the malting process.

FIGURE 3.—*General view of steep tanks and malting drums in a malt house in Canada where the Galland-Henning process is used.*

After being thoroughly cleaned and graded, the barley is placed in the steep tanks. These tanks are generally placed directly above the drums so that the steeped barley can be conveniently spouted to the drums beneath.

Steep tanks are cylindrical in shape with a conical bottom, provided with a strainer valve. The cleaned barley is submerged in water until saturated.

One tank serves two drums, the steeping process requiring from 40 to 65 hours, whereas the drums operate on a six-day germinating period.

Uses of Malt

Barley malt is the chief material used in the brewing industry. It is sold under the following names, Standard, Choice, Fancy, High Dried, Munich and Pilsner malts. It is also used in the form of Caramel, Black, and Dextrine malts.

Brewers malt in Canada must be of good quality and especially high in extract because of the high duty of six cents per pound imposed on malt.

In the distilling industry malt of high diastatic power is used and is usually called distiller's malt. It differs from brewer's malt in this respect, that it is much higher in diastatic power. In order to get the high diastatic value, it has to be malted, and especially kilned, differently to brewers malt.

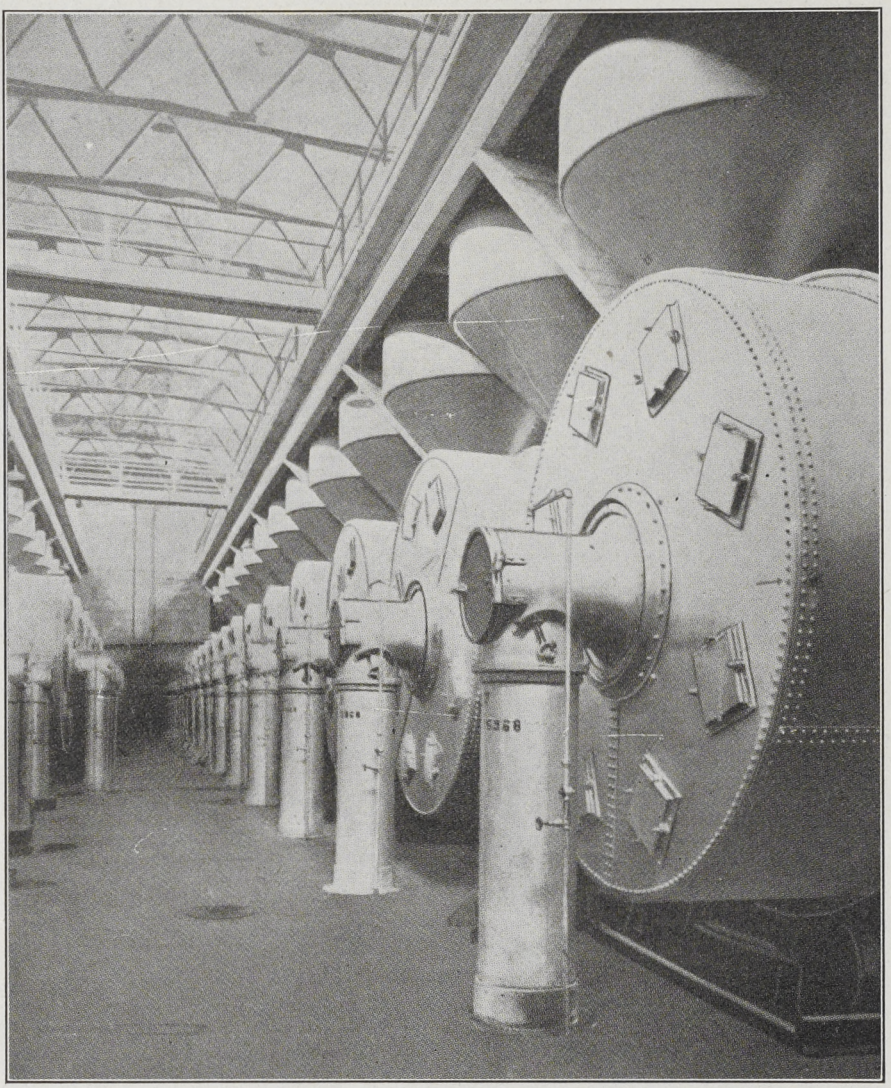


FIGURE 4.—*View of malting drums in a malt house in Canada where the Galland-Henning process is used.*

The saturated barley descends from the steep tanks to the malting drums. An even temperature is maintained by forcing attemperated air through the germinating barley which is constantly kept in motion by the slowly revolving drums. From the drums the germinated barley is conveyed to the kiln.

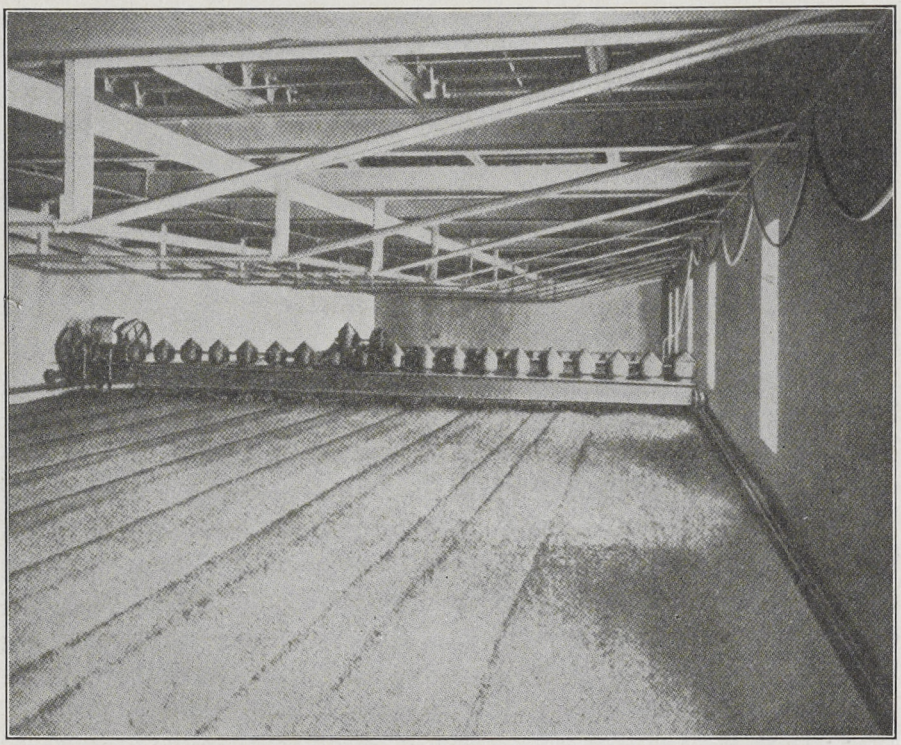


FIGURE 5.—*View of lower kiln floor—Galland-Henning process.*

The kiln consists of a tall building adjacent to the drum house. On the ground floor are the furnaces for heating the air. Above the furnaces are two floors of perforated iron on which the green malt to be dried is loaded, and above these floors are the kiln fans which draw the heated air through the drying malt. The drying process is begun on the top floor and finished on the lower floor.

An electrically operated malt turner travels backwards and forwards the full length of the room thoroughly stirring the malt to insure even drying. Each floor consists of perforated dumping trays which can be tilted to allow the partially dried malt to descend from the upper floor to the lower, and when completely dried to be dumped from the lower floor into hoppers from where it is conveyed to the cleaner and then stored.

High diastatic malt is also used in the production of yeast, vinegar, and the preparation of breakfast foods as a flavouring material. It is used in the manufacture of malt syrups, extracts and in malted milks. Malt is also employed a great deal in the production of a number of non-alcoholic beverages such as coffee, Postum, etc. Malts to a certain extent are used as the main source of diastatic extract in the textile and laundry industries and also in the baking industry. Malt as malt extract is used also as a proprietary medicine, due to its property of being able to convert starches into maltose, the most digestible of the sugars.

BREWING BARLEY MALT

HERBERT G. SCHUCK [1]
Dawes Brewery, Montreal, Quebec

The brewing process is carried out in five operations; mashing; boiling of wort; primary fermentation; secondary fermentation and ageing; filtration and filling into bottles and trade casks.

During the mashing operation, the wort is prepared by mixing the ground malt with water at the proper temperature; the starch in the ground malt is converted into fermentable maltose; unfermentable dextrine and the insoluble albuminoids are made soluble by means of the enzymes which are natural constituents of malt formed in the barley during its growth.

The phosphates and other ingredients of malt are extracted and also the malt flavour.

It is in the mashing process that the foundation is laid for the proper combination of alcohol and extract, by producing the proper quantity of fermentable and non-fermentable sugars in the extract.

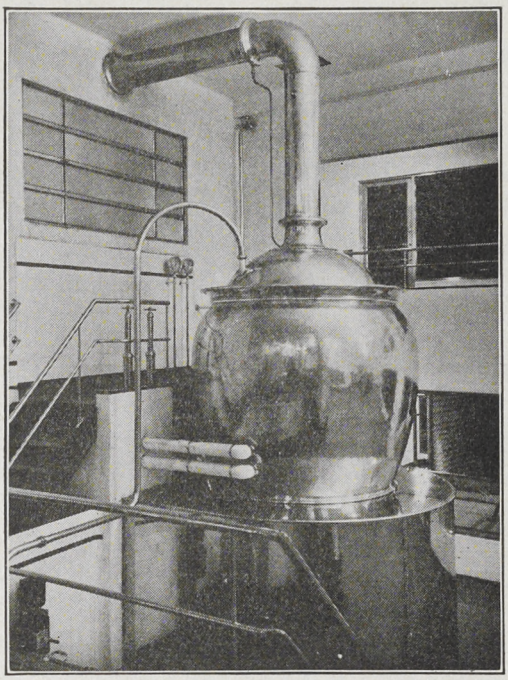


FIGURE 1.—*The brewing kettle in an experimental plant maintained by a modern Canadian brewery. It is made of copper, highly polished both inside and out, with dome and vent pipe also of copper.*

During the boiling operation the filtered wort from the mash tun is boiled with the hops. Certain albuminoids are precipitated by the heat. The hop aroma, hop bitter, and tonic qualities are extracted and the wort is concentrated.

During the primary fermentation the yeast which is added to the cooled and filtered hopped wort converts the fermentable sugars into ethyl alcohol and carbonic acid gas. The yeast reproduces itself and is collected for brews that are to follow. Hop resin and proteids are eliminated and a few other products of minor importance are formed.

Fermentation might be defined as the changing of maltose into equal parts of ethyl alcohol and carbonic acid gas, through the agency of yeast.

[1] General Superintendent.

Brewer's yeast, or *Saccharomyces Cerevesia,* is a unicellular plant and belongs to the fungi group. It is composed of round and oval shaped cells having a cell wall, a nucleus and protoplasm. Yeast propogates by budding and under unfavourable conditions by sporulation. It requires for its growth and reproduction, carbohydrates in the form of fermentable sugars, proteids in the form of soluble albuminoids, phosphates and oxygen.

FIGURE 2.—*An experimental ale storage room showing tanks constructed of various materials.*

In malt extract or wort it finds these constituents in a very favourable proportion and when yeast is placed into wort the following changes take place. The sugar, through osmotic pressure, passes into the yeast cell and the enzyme zymase changes the sugar into alcohol and carbonic acid gas and expels them from the cell. The proteids, phosphates and salts pass into the cell and are used for its growth and reproduction. During the growth new cells are produced.

Observed under the microscope while growing, we find that small spots like pimples form on the outside of the yeast cell and these gradually become larger and separate from the mother cell and in time also have buds on them. The budding cells usually cling together and only break away from the mother cell when several have been formed, and each cell in turn produces new colonies.

We know today that life is not actually necessary to change sugar into alcohol, but that the products of life, the enzymes, do the work.

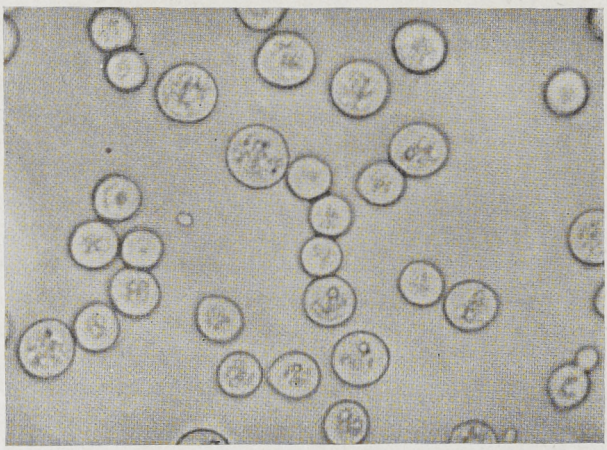
We can destroy the life of the yeast by rupturing it with pressure and gritty material, extract the enzymes, and ferment sugar with them, but this is not done in practice.

There are two types of *Saccharomyces* used in brewing. One is a top fermenting yeast, mostly round cells, which is used for ale and porter. The fermentation is carried on at moderate temperature; the yeast grows rapidly and is carried to the top of the beer where it is collected for future use. The other is a bottom fermenting yeast, mostly oval cells, used for lager. The fermentation is carried on at lower temperature. The cells grow slower and settle to the bottom of the beer where they are collected for future use.

The yeast must be free from foreign organisms. The brewer takes every possible precaution to prevent infection by keeping all vessels sterile and filtering all air that comes in contact with the beer.

Many brewers use yeast developed from a single carefully selected cell. This was made possible by the wonderful research work of Pasteur and Hansen. The amount of yeast used in beer is about one pound per barrel of beer. The yield is about three pounds per barrel of beer fermented.

During the operation of secondary fermentation and aging, the cooled beer from the fermenters continues to ferment very slowly, the beer clarifies by sedimentation, and a slow oxidation of a small portion of the ethyl alcohol takes place which forms esters, which produce the fine flavours.



PHOTOMICROGRAPH, SCHWARTZ LABORATORIES, 900X.

FIGURE 3.—*Ale yeast. Many brewers use yeast developed from a single carefully selected cell, a fresh supply being grown weekly in some breweries.*

In general, the brewer tries to produce a non-intoxicating beverage which has slightly stimulating qualities derived from the alcohol — slightly tonic qualities derived from the hops—thirst quenching qualities derived from the sterile water—refreshing qualities derived from the carbonic acid gas—appetizing qualities derived from the hop bitter—and nourishing qualities derived from the malt extract.

BARLEY FOR MILLING PURPOSES

H. Armitage [1]
Ogilvie Flour Mills Company Ltd., Winnipeg, Manitoba

The problems confronting the miller engaged in the production of pot and pearl barley have been considerably multiplied during recent years due to the difficulty of securing sufficient quantities of the standard quality desired. A very high quality only is acceptable to the housewife and the manufacturer of food products. To produce the desired grade of milled product, the following qualifications are necessary: (1) The barley must be white and free from discolored kernels; (2) it must be uniform in size, and (3) it must be free from foreign matter.

(1) *Colour*:—The first and foremost requisite is that barley suitable for milling must be free from colouring matter in the bran layers, and that the endosperm be as white as possible. Of the barleys produced in Western Canada at present, those possessing bluish-green bran layers and greyish endosperm predominate. These types obviously cannot be used. Furthermore, samples consisting of a mixture of bluish-green and grey kernels and white kernels offer limited scope. Of the two classes of barley, the two-rowed and the six-rowed, the six-rowed is not always passable, as from time to time it contains a smattering of bluish-green as well as grey kernels. Hence, there is in effect only one class that is entirely satisfactory from the standpoint of colour, and that is the two-rowed. As the process of decortication does not entirely dispose of the branny layers in the case of pot barley—although in pearl barley which is about half the size of pot barley the bran is almost completely eliminated—the importance of securing supplies of uniform white grain may be realized.

(2) *Uniformity of size*:—Uniformity of size in the finished product is highly desirable. This can be secured either by grading the grain according to width and length, or by reducing the different sizes of barley kernels to one common standard of finished product. Both of these methods are costly, but the first is preferable. As the offal, consisting of husks, bran and flour, for which there is a limited demand at a relatively low price, amounts to approximately 50% of the barley used, it is evident that any factor which reduces the quantity of offal produced during the conversion process must necessarily tend to reduce the cost of the finished product. This is the main reason for the importance of uniformity of size.

(3) *Freedom from foreign matter*:—Any mixture of foreign grains and extraneous matter complicates the elimination process in the initial stages and adds materially to the cost of production.

With only, in effect, two-rowed barley with which to work, and only limited supplies of it available, the industry is very much restricted in its scope. Furthermore, the high premiums that have ruled for this grade of barley during the past few years have made it impossible to bid for the export trade which could be developed.

In order to permit of the expansion of the barley milling industry, greater encouragement should be given to the growing of suitable two-rowed varieties. Western Canada is naturally adapted to the growth of this class of barley, and the markets that could be served offer a wide field.

[1] Manager, Pot and Pearl Barley Department.

BARLEY AS A HOG FEED

R. G. KNOX [1]
Ontario Agricultural College, Guelph, Ontario

Barley is one of the greatest energizing, heat-giving, and fat-forming concentrates extensively grown in Canada, and is recognized by breeders of bacon type hogs the world over as being one of the best feeds that may be used for the production of high quality bacon. Further emphasis on the value of this cereal grain as a hog feed is made when one realizes that barley is fed extensively in the areas in Canada from which our best quality bacon type hogs come.

Until recent years this grain was considered as being only suitable for finishing hog rations. Fortunately, however, recent investigation has revealed the fact that it may be satisfactorily included in the basal ration for all classes of swine, provided proper recognition is given to the purpose for which the hog is being fed and the proportion of barley fed accordingly.

A study of the composition of barley reveals that it is comparatively low in protein and very low in fat, with a reasonable amount of ash and a very high nitrogen-free-extract content. As a feed it has the same deficiencies as all of the other small grains, namely, proteins of not too high quality, a low level of calcium, and a lack of vitamins A and D. The digestion co-efficient of barley, however, is approximately 80, which is comparable with wheat and corn. It is higher in digestible protein than corn; consequently smaller quantities of other protein-rich feed is required when barley is fed, with a resultant reduction in cost of production.

In Canada the oat is, in spite of its high fibre content, considered by many to be superior to barley for very young pigs if fed singly, but in Denmark the reverse opinion obtains and nursing pigs are fed cracked barley in the "creeps". It is however unanimously agreed in all bacon producing countries that barley is more efficient than oats for fattening hogs by 5 to 15%, and that it is slightly superior to wheat as a hog-feed. Grinding increases the feeding value of barley approximately 15%. It is not wise, however, to grind it too finely.

As already suggested, barley in itself is not a complete hog feed, and as a consequence best results are obtained when it is blended with other Canadian grown grains along with sufficient protein supplement to properly balance the ration and to make for greater variety and palatability, which are essential requisites in hog feeding. Provided that the aforementioned requirements are satisfied barley may make up 20% or more of the basal ration for a weanling pig and be increased to 70% for the finishing hog. In the Danish Pig Testing Stations the basal ration for pigs of all weights is 50% barley, and on commercial pig farms a higher percentage than this is fed. In Great Britain the percentage of this cereal in swine rations ranges from 40% to 60%, depending upon the purpose for which the pig is being fed. Naturally for pregnant sows, nursing sows, and service boars, a lower percentage is fed, as is also the case in Denmark.

During recent years considerable co-operative experimental work has has been carried on at Experimental Stations and Colleges in connection with hog feeding under the direction of the Advanced Registry Board for

[1] Professor of Animal Husbandry.

Swine. As a result of this investigation to date the following rations are being used at the various Testing Stations:

BASAL RATION

	1ST PERIOD GROWING	2ND PERIOD FINISHING
Barley	50	60
Wheat	20	30
Oats	30	10

PROTEIN SUPPLEMENT

Tankage	50
Fishmeal	15
Linseed Oilmeal	25
Salt Iodized	5
Limestone or Bonemeal	5

In the 1st Period 85% of the basal ration is fed along with 15% of the protein supplement. In the 2nd Period 90% of the basal ration is fed with 10% of the protein supplement. Attention should be called to the fact that pigs coming to the Testing Station have passed the weanling stage, consequently there is no occasion for the provision of a weanling ration. It must be borne in mind that while the protein supplement outlined above is being used at the different Testing Stations, there is no reason why the dairyman cannot utilize his dairy by-products to full advantage along with the grains recommended.

A considerable amount of progress has been made in the improvement of the breeding stock of the country. Any benefit that may emanate from this improvement is dependent upon the manner in which our Canadian hogs are fed and marketed, so far as the producer is concerned. In this article an attempt has been made to point out the merits of one of our most commonly grown cereal grains in the production of quality bacon.

Canadian bacon of suitable quality commands recognition on the British market today. Canada has the potential power of producing a decidedly greater volume of bacon than is being marketed at the present time. She has the right type of hog and she grows the kinds of feed that will make suitable bacon for export.

BARLEY AS A FEED FOR CATTLE

G. E. RAITHBY [1]
Ontario Agricultural College, Guelph, Ontario

Barley is the greatest fattening and energy supplying feed grown extensively throughout Canada. As such, it finds a very important place in the concentrate mixtures fed to beef and dairy cattle as well as in the rations supplied to other classes of live stock. The following figures on the digestible nutrients and the composition of barley taken from the 20th edition of Morrison's Feeds and Feeding are of interest in determining the characteristics of this feed.

[1] Associate Professor of Animal Husbandry.

Digestible Nutrients	
Dry Matter	90.4
Digestible Crude Protein	9.3
Total Digestible Nutrients	78.7
Nutritive Ration	1:7.5

Average Composition	
Protein	11.8
Fat	2.0
Fiber	5.7
Nitrogen Free Extract	68.0
Ash	2.9

Barley has a low protein content and like most cereal grains this protein is not of particularly good quality. The total digestible nutrient content is high although somewhat lower than wheat and corn. Barley has a low fat and fiber content. The amount of mineral material is small and this is low in calcium, another typical characteristic of cereals. Barley is rated as a good source of vitamins B and E and has insignificant amounts or an absence of A, C and D.

In preparing barley for cattle feeding it should be coarsely ground or rolled. Very fine grinding tends to make the concentrate mixture heavy and pasty. Even for calf feeding crushing or rolling is recommended.

Barley as a Feed for Beef Cattle:—

Barley is so extensively used in the rations for fattening cattle that much that could be said here is merely a reiteration of facts well established by experiment and experience. This feed produces a good quality of finish, is available in most districts where steers are fattened and usually finds a satisfactory market through steers. When heavily fed on barley over long periods of time steers sometimes appear to tire of this feed. To overcome this, the proportion of barley in the concentrate mixture should be rather small at the commencement of the finishing period and gradually increased until at the close barley makes up about two-thirds of the mixture.

Boiled barley is used by some feeders in fitting steers where a special finish is desired. This cooking seems to improve the palatability, permits of the feeding of larger quantities without the apparent "tiring" or going off feed. Because of the expense involved it is doubtful if it is economical for regular feeding and is used under circumstances where a special finish is desired.

Much discussion has centred around the merits of corn and barley as fattening feeds for steers. The following statement from Morrison's latest edition is rather significant: "In 24 experiments in which ground barley has been fed as the only or the chief grain in direct comparison with corn, the average gains of the barley-fed cattle have equalled those of the corn-fed cattle. This average of these many experiments shows that the opinion, often expressed, that cattle will gain faster on corn than on ground barley is incorrect."

For beef cows barley can be used as a part of the concentrate ration. Quantities somewhat smaller than are fed to steers would be satisfactory, about one-third to one-half of the concentrate mixture.

Barley as a Feed for Dairy Cows:—

As a source of easily digested carbohydrates barley has an important place in the rations for milking cows. It should not be fed just before or immediately after calving. Any heavy feed may tend to aggravate

the already congested condition of the recently freshened udder and for this reason feeds of a laxative, bulky nature should be given. Some feeders claim that barley tends to dry up cows but there is no very sound evidence to support this statement.

Recently the Ontario Agricultural College conducted an experiment with milk cows fed on concentrate rations containing 18%, 40% and 70% barley. All mixtures were built up to a protein level of 18% and fed with roughages consisting of good quality mixed hay, corn silage and mangels. The 18% and 40% rations were much alike in respect to palatability, cost, reaction from the cows and quantity and quality of product produced. Difficulty was experienced in keeping the cows on feed with the 70% barley ration. At times there were indications of slight bloating. Because of the large amount of protein rich feed necessary to bring a concentrate mixture containing 70% of barley up to 18% protein, it proved rather costly. Experimental evidence indicates that with the exception of calving time, amounts up to or more than a third of the concentrate ration may safely consist of barley.

Barley has some liabilities as a feed for cattle but its assets, namely, high yield of nutrients per acre, reasonable assurance of an annual crop, high quality of finish produced on meat producing animals, and its net energy value as a milk producing feed far offset any undesirable characteristics. The judicious use of this feed should result in quality products at low cost of production.

BARLEY AS A FEED FOR POULTRY

H. S. Gutteridge [1]
Central Experimental Farm, Ottawa

It has been estimated that during the year 1935 with a poultry population of 57,000,000, the total consumption of grains by poultry in Canada was approximately 75,000,000 bushels, of which about 25% would be barley. These figures, while indicating the degree to which this grain has been utilized in the past, may or may not accurately reflect the comparative desirability of the grain for poultry feeding purposes, since numerous factors, principal among which is availability to definite areas, very often determine the grain used regardless of suitability. A brief review of the available information with regard to the value of this grain for poultry feeding purposes is in order.

Individual Characteristics

Under this head may be considered the physical characteristics of the grain, its nutrient content and the availability of these nutrients as determined by digestibility trials with poultry.

Physical:—The most important expression of physical characteristics in so far as poultry are concerned is palatability. In this respect barley is definitely of inferior quality to wheat and corn. That this is so is due without doubt to the amount and nature of the hull, since hulless or hulled barley is eaten with avidity. It should be noted however, that poultry which have been accustomed to barley throughout their growth make no

[1] Poultry Husbandman.

reservation in this respect. Consequently, once accustomed to the grain they will eat it readily. Poorly threshed barley with awn adhering is not relished for obvious reasons.

Nutrient Content:—Nutrient content as shown by chemical analyses, while by no means an accurate indication of the value of a grain, should be considered briefly for reasons of comparison with other grains. In mineral content, barley is 30% higher than wheat, 45% higher than corn and 23% lower than oats. In proteins, differences are small between these grains with barley in an intermediate position. In fibre, barley is 52% higher than wheat, 57% higher than corn and 58% lower than oats. In nitrogen free extract, barley is superior to oats by 15% and approximately equal to the other grains. In fat barley is approximately equal to wheat and lower than corn and oats by 58% and 52% respectively. In elaborating upon these qualities in so far as poultry are concerned, minerals are of considerable importance in view of the rapid growth rate and the high level of production in eggs in proportion to body weight of which poultry are capable. High fibre is distictly disadvantageous from the standpoint of palatability as mentioned above, because it is almost entirely indigestible to poultry and because of its physical bulkiness which makes it unsuitable for chick rations. The other differences cited above are relatively unimportant in so far as is known.

It should be mentioned in this connection that the grains are of almost equal vitamin value with the exception of Vitamin A which is found in any quantity only in corn and of which this grain is a fair source. Since the requirement of poultry for this vitamin is relatively very high this deficiency under certain conditions may be of considerable importance.

Availability of Nutrients:—In the final analysis the proportion of the nutrients of any grain which is assimilated into the body and may be used for maintenance of the various body processes and for production is the most satisfactory guage of the nutritive value of that grain for the particular class of stock from which this information was obtained. Digestibility trials with poultry have indicated that the protein of wheat, oats, corn and barley is approximately equally digestible. The digestibility of carbohydrates (exclusive of fibre) is 13% greater for barley than for oats while that of corn and wheat is approximately equal and 8% and 7% respectively higher than barley. In fat, that of corn and oats is almost equally digestible and 25% and 36% more digestible than that of barley and wheat respectively.

In considering nutritive value it should be always borne in mind that analyses when given, whether chemical or digestible, are subject to a great deal of variability from sample to sample of the same species of grain. Analyses are therefore only an approximate guide and serve to give only a general picture of the comparative worth of the grains.

Comparative Value During Growth, Egg Production and Fattening

A great mass of data is available from the results of numerous feeding trials undertaken with the intention of indicating the feeding value of the different cereal grains. A review of these data discloses a lack of agreement which is explainable when the numerous possible differences in the grain samples used, in the environment in which the tests were carried out, and in the experimental technique employed in various locations are

considered. A complete review and analysis of such experiments by E. W. Crampton discloses the following information which is to be accepted as "the probable situation as judged from the evidence available."

Barley for Growing Stock:—Barley and corn are approximately equal in value for the production of growth providing the vitamin A deficiency of the former is compensated for by satisfactory supplements. The supplements most commonly used for this purpose are green feeds, fresh or properly dried, and vitamin carrying fish oils. Apparently there is a tendency for chick mortality to be slightly higher on corn than barley rations. Palatability did not appear to be an important factor with young growing stock.

Barley and wheat are apparently equally efficient in production of gains. Consistently heavier mortality was experienced with wheat than with barley, however.

Barley gives growth approximately equal to oats if the hull of the latter has been removed. The entire grain is not satisfactory for young chicks.

Apparently therefore, there is little to choose between barley, wheat, oats and corn in the matter of ability to produce growth, with the exception that the vitamin A content of corn gives that grain an advantage over the other grains, while the high fibre content and coarse hull of oats, and barley to a lesser extent, make them less suitable for chicks. A definitely higher mortality is also the case where wheat is fed.

Barley for Egg Production:—When barley and corn are ingredients of properly balanced rations they are apparently approximately equal for purposes of egg production. Twenty-six separate experiments on the Experimental Farm System in various parts of Canada, covering a period of seven years have indicated this to be the case. Where the ration was not sufficiently well balanced that the vitamin A content of yellow corn was compensated for in the barley ration, corn became the more efficient grain from the standpoint of both production and livability.

Additional factors worthy of note are that yellow corn produces more highly coloured yolks than does barley, and that upon free choice, corn is more readily eaten by mature stock than is barley.

Barley for Fattening:—Disagreement as to the comparative merits of the different grains is very marked where fattening is concerned and data are somewhat meagre. W. A. Maw, in contrasting corn, wheat, oats and barley, in crate fattening at levels of 94% of the ration found barley to be 17% less efficient than corn, 5% less efficient than wheat and 9% more efficient than oats. The author, feeding 100% of the grains or mixtures found a 2:1 oats and barley mixture to be 23% less efficient than corn, and 9% less efficient than wheat, although the actual difference in the latter case was not statistically significant.

In considering the information reviewed above it seems to be fairly evident that each individual grain possesses particular characteristics which make it efficient for certain definite purposes and less so for others. If it were possible to form an estimate of the values to poultry of the grains considered it would appear that yellow corn is perhaps outstanding in growth, production and fattening ability, whereas oats suffers by comparison to some extent. Barley and wheat are apparently intermediate in value, with the latter slightly more desirable for most purposes.

MARKETING OF CANADIAN BARLEY

THE MARKET FOR BARLEY IN CANADA

H. G. L. STRANGE [1]
Searle Grain Company Limited, Winnipeg, Manitoba

Barley is considered by some authorities to be the oldest of our cultivated grains. We are told that all civilization and human progress has been made possible by the fact that man—or more probably a woman—ages ago, discovered, probably by accident, that the seed of certain grasses cast upon the upturned ground would bring forth manyfold, and that, moreover, such seeds were an almost perfect food for human beings. From this time forth the struggle for food did not take up the whole of man's time; therefore he had leisure to devote himself to the advancement of arts and sciences. If this is true, then it will be seen how much mankind is indebted to the barley plant.

At one time barley probably formed a large percentage of the food of the people in certain areas of the world. Today, however, it is little used as such, excepting perhaps in Tibet and adjoining countries. There are indications in history that not only was barley valued in the earliest of times as an important food, but that actually it was used as a standard of value and perhaps as money itself. In Mesopotamia, during the reign of Hammurabi, the King of Babylon, who reigned from 2067 to 2034 B.C., the famous Law Code of King Hammurabi, reveals that under certain circumstances wages and rents were payable in "gurs" of barley.

Barley appears to have declined somewhat in importance since those early days, and today it has to take third place instead of first, in volume of cereal production. It is still grown widely in many parts of the world, but it is now principally as a feed for live stock. A certain amount, however, is still used for human food in the form of bread in Tibet and other countries, as already stated; also to some extent as a breakfast food and as a substitute for coffee, principally in North America; and it has certain other minor foodstuff uses. Perhaps next to its use as a grain for live stock feeding, the most important use for barley is for distilling and malting purposes.

Barley occupies in Canada about 12 per cent of the volume of all grains produced annually. The area in barley in the whole of Canada averages about 4 million acres (wheat averages 27 million). The average production of barley for the last six years has been approximately 75 million bushels.

For the three Western Provinces, Manitoba, Saskatchewan and Alberta, just over 3 million acres are seeded each year to barley and the average production for the last six years has been approximately 54 million bushels. The bulk of the barley produced in Canada, including the West, stays on the farms on which it has been grown, and is used for live stock

[1] Director, Research Department.

feeding. Out of the total production in Western Canada of 54 million bushels annually not more than a yearly average of 14 million bushels is hauled to elevator companies for both feeding and malting purposes.

Of this amount of 14 million entering into commercial channels about 28 per cent during the past six years on the average has qualified for the 3 Extra CW Six-Row malting grades, as compared with only eight per cent in 1927; the great bulk of it all, however, being in the six-rowed grade.

It is interesting to note that from August 1st to November 6th, this current crop year, no less than 68 per cent of all the barley entering into commercial channels has been admitted to the malting grades.

The premiums paid for the malting grades over and above the 3 CW were 4⅛ cents on the average for 1932; 23⅜ cents in 1934; 7½ cents in 1935; and so far for this current crop year the premium has averaged 27⅝ cents a bushel.

It will be observed that only a small part of the barley produced in Canada enters into commercial channels, and that a still smaller part finds a market for malting purposes, also that the bulk of the barley produced in Canada is actually used for feeding purposes on the farm itself.

It would seem that there is, therefore, a large field for the use of the best varieties of *feeding* barleys, as well as varieties for strictly malting purposes. Inasmuch as yield, stiffness of straw and earliness are the dominant factors that influence and govern the profitable production of barley for feeding purposes, and inasmuch as smooth awns have much to do with making the actual operations of barley production easier and much more pleasant for all workers, and that the straw from such varieties is a better live stock feed, then it would seem that the matter of malting quality might well be ignored where the chief use of the barley variety is for live stock feed only. Naturally, however, if a barley variety could be produced that would embody the good characteristics mentioned—stiffness of straw, earliness, high yield, thinness of hull, smooth awn, and in addition acceptable malting qualities—it would be an important money-making contribution to Canadian farmers. Here, apparently, is a goal to be sought worthy of the best efforts of our plant breeders and of our scientific agricultural institutions. Such a variety, if it were found to be suitable over a wide area, would provide each year a large bulk of barley acceptable both to Canadian feeder and maltster, and which would be suitable for export markets as well.

This is of particular interest when it is recalled that almost every barley marketing expert who has come from abroad to Canada, has made the statement that steady annual quantities and regular quality are the primary requisites for the capture and holding of foreign markets.

It is courteously suggested, therefore, that our governments, both Dominion and Provincial, might well consider making increased appropriations available to Field Husbandry Departments of our Universities and to our Dominion Experimental Farms, so that the work now being undertaken in attempting to produce what might be called a perfect barley for Canada, might be enlarged and accelerated.

THE MARKET FOR FEED BARLEY IN CANADA

F. W. PRESANT[1]
Toronto Elevators Limited, Toronto, Ontario

There appears to be good reason to believe that the use of barley as a feed for poultry and live stock has not yet reached its full possibilities among Canadian feeders. Following the very large crop of barley in Canada in 1930 a real effort was made through governmental and other agencies to further the increased use of barley as feed. This campaign undoubtedly produced results. Not only was a great deal of publicity material distributed at the time, but in general, experimental farms and stations took up the question and worked on various rations to try to learn to what extent barley might be included. This work is still going on, though possibly in a more limited way. As a result of the efforts of past years a better knowledge of the place which barley holds in relation to our feeding practices is becoming known. However, more research work is needed and continued efforts along publicity lines should follow. If this is not done and the average feeder is left in any doubt as to the actual necessity for, or importance of barley in his various rations, its use will fluctuate within wider ranges than would be normally indicated as a result of the comparative cost of barley with other feed grains.

From a national standpoint barley appears to occupy a unique place among our Canadian cereal crops. In an article by H. R. Hare in the *Economic Annalist*, February, 1936, he states: "A study of the long time average yield of this crop computed on a total digestible nutrient basis reveals that no other crop in any province attains to the high standard set by this cereal." (Table 1).

TABLE 1.—COMPARATIVE LONG TIME AVERAGE, YIELD OF CEREALS IN TOTAL DIGESTIBLE NUTRIENTS IN CANADA BY PROVINCES*

	Barley	Wheat	Oats	Rye
Canada	100	89	81	78
Prince Edward Island	100	82	75	—
Nova Scotia	100	88	85	83
New Brunswick	100	87	71	85
Quebec	100	90	72	85
Ontario	100	96	63	67
Manitoba	100	86	84	78
Saskatchewan	100	91	87	84
Alberta	100	90	86	71
British Columbia	100	93	92	70

TABLE 2.—DISTRIBUTION OF THE TOTAL AVAILABLE BARLEY SUPPLY IN CANADA IN PERCENTAGES

	1930-31	1931-32	1932-33	1933-34	1934-35
Exported	11	13	6	2	19
Milled for consumption	1	1	1	1	1
Malting and brewing	2	4	5	7	7
Seed	4	7	7	9	10
Stored	17	7	12	14	9
Lost in cleaning	1	1	1	4	2
Fed on farms or otherwise used	64	67	68	63	52

**The tables used in this article are here given with the kind permission of Mr. H. R. Hare, Economics Branch, Department of Agriculture, Ottawa, and were computed from data collected by the Dominion Bureau of Statistics.

[1] Manager Feed Department.

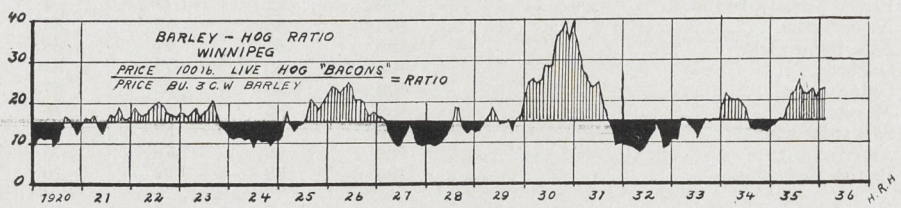
It is interesting to note that in the distribution of available Canadian barley, that portion fed on farms or otherwise used represents a greater proportion than the amount distributed in all other outlets. The percentage used, however, shows a considerable variation. (Table 2).

To further bring out the extent of the variation in actual amount of barley put to use as feed Table 3 is submitted.

TABLE 3.—RANGE OF VOLUME OF BARLEY IN CANADA DISTRIBUTED THROUGH THE DIFFERENT CHANNELS 1930-31 TO 1934-35

	High Year		Low Year		Range during 5-year period million bushels
	Year	Million Bushels	Year	Million Bushels	
Available for distribution	1930–31	177.7	1934–35	80.4	97.3
Exported	1930–31	19.2	1933–34	1.7	17.5
Milled for consumption	1930–31	1.3	1934–35	0.6	0.6
Malting and Brewing	1934–35	6.0	1930–31	3.0	3.0
Retained for seed	1934–35	7.7	1933–34	7.2	0.5
Stored	1930–31	29.5	1934–35	5.5	24.0
Lost in cleaning	1933–34	2.9	1932–33	0.8	2.1
Fed on farms or otherwise used	1930–31	116.9	1934–35	44.1	72.8

As previously suggested the cost of barley to feeders and this relationship to the current prices at which live stock is selling undoubtedly has been and will continue to be an important factor regulating consumption. Mr. Hare has computed the price for live bacon hogs per cwt. at Winnipeg in comparison with the price of No. 3 C. W. Barley per bushel at Winnipeg over a sixteen-year period from 1920-1935. The average price of live hogs was $9.72 per cwt. and for barley 63.4c. per bushel. On this basis, it took an average of 15.3 bushels of barley to equal the price of one hundred pounds of live hog. The figure below plots the ratio of these prices.



As stated in the article by Hare, the profitable periods of hog production were those periods when the price of a greater number than 15.3 bushels of barley was required to equal the price of one hundred pounds of live hog. These periods are shown above the base line on the chart.

Feeding Barley to Live Stock

Cattle.—Cattle in the East are not, as a rule, fed much barley except in years of low barley prices. Feeders have been somewhat prejudiced against barley in quantity for cattle preferring to use larger quantities of oats and in the case of dairy cattle mill feeds. In some parts of the East fairly large quantities of corn are used when available in feeding fat cattle. There should be a field here for a more intelligent use of larger quantities of barley in

cattle rations. We believe that since many feeders have been using crushed grains, barley is being accepted more readily to occupy an important place in the ration. For crushing it must be clean and free from wild oats.

Hogs.—Hog feeders have a high appreciation of the value of barley. However, there is no doubt but that an even larger proportion of barley than is now used by most could be profitably fed if supplemented by the proper kinds of proteins and minerals in the ration.

Eastern feeders like Western barley for feeding, but prefer 3 C.W. Barley to the lower grades. Since oats are usually fairly abundant on Eastern farms, the feeders would prefer a pure barley, free from weed seeds. The wild oats found even in 3 C.W. Barley are frequently objected to. There is a market for some of the lower grade barley if the price differential is sufficiently attractive. This market would be considerably better if the lower grade barley came to market free of small weed seeds and with wild oats reduced to a minimum.

Poultry.—Considerable work of value has been done in studying the value of barley in poultry feeding. There is no question as to the evidence that barley has of late years been used more extensively in poultry rations. It should continue to be used in combination with other grains in poultry mashes. More of it, too, may be used in the whole grain ration when it is fed crushed. The palatability of barley is increased by crushing as compared with its use whole. Here again, however, a clean, pure grade of barley is demanded.

Barley, for poultry, in the eastern provinces will, we predict, never reach the importance of wheat, oats and corn. It has definite limitations on its use. Price, in comparison with other cereal grains, may alter the volume used to a slight degree.

In the East the general practice is to use barley in practically all mash mixtures for poultry of all ages. The percentage varies from about five per cent to fifteen per cent, as a rule. Individual cases may prove the exception. In the West much larger percentages of barley are used in formulating poultry rations, but there corn is not so readily available nor are the poultrymen so used to rations with a large amount of corn included. Eastern poultrymen feel that they must have corn to a certain extent regardless of the cost.

Only the best grades of barley are desirable for poultry feeding; 3 C.W. Barley as it is sold to-day is not sufficiently clean and free from weed seeds. To increase the use of barley for poultry, the first step should be to provide a more suitable grade of clean, plump barley.

Conclusion

All evidence would point to the possibilities of a greater consumption of barley for feed in Eastern Canada. This must be assisted by having cleaner grades of barley come to our markets. Research work should be continued to study the uses of barley. The findings should be given plenty of publicity. Since barley will have to compete on a price basis with all other cereal grains used for feed more attention and study should be given to the economics of production of the crop so that it may always be available at a cost favourable to its use to replace the other cereal grains to the extent found profitable, results considered.

THE AMERICAN MARKET FOR BARLEY

LeRoy D. Godfrey [1]

Winnipeg Grain Exchange, Winnipeg, Manitoba

To write under the above title is to write about something which in recent years is very unusual. Since the days of high import duties on barley into the United States, that country has imported barley in any considerable volume only when there has been a crop disaster, to be specific, during 1934 and during the present crop year of 1936. Almost all of the barley that has been imported by the United States during those two years has been used for malting, not for animal food.

During the ten years preceeding 1890, the United States imported, on the average, ten million bushels of barley per year from Canada, practically all of which was raised in Ontario. The import duty during this period was ten cents per bushel. In 1890 the duty was raised to thirty cents per bushel, which duty remained in effect until 1913, when it was reduced to fifteen cents per bushel. In 1922 it was raised to twenty cents per bushel which rate is still in effect.

From 1890 until 1934, the amount of Canadian barley imported by the United States was so small that it was not even recorded separately in official statistics. In 1933, after the repeal of the 18th Amendment, there was an immediate and urgent demand for malt on the part of United States brewers. There was no shortage of malting barley, but there was a shortage of malt and malting capacity; thus Canada in 1933 exported to the United States considerable quantities of malt. It takes approximately one bushel of barley to make a bushel of malt, and strange as it may seem, the import duty into the United States is only fourteen cents per bushel on malt, the manufactured article, as compared with twenty cents per bushel on barley, the raw article. This duty has been in effect since 1922. Previous to that time the duty on malt into the United States was from fifty to one hundred per cent greater than the duty on barley.

In 1934 about twice as much Canadian malt was imported by the United States as was imported in 1933. The demand continues. It is quite possibly aided by the favorable duty on malt as compared with barley. Very little Canadian barley is used in the United States for purposes other than malt, but in 1934 some No. 3 Extra C. W. Barley, Two Row, was exported by Canada to the United States to be used for pearling purposes.

The requirements of malting barley in the United States are running currently in the neighborhood of 75 million bushels per annum. The United States barley crop in recent years has varied widely as to size, due principally to vagaries of the weather. In 1932 the crop was 302 million bushels. In 1933 this dropped to 153 millions, and in 1934 it suffered a further reduction, being only slightly in excess of 116 millions. In 1935 the crop was again a substantial one, being about 282 million bushels. The crop again suffered in 1936, being estimated at about 145

[1] Member.

million bushels, much of which is very light weight. A large proportion of the United States barley crop is never fit for malting and naturally is used for feed.

Most of the demand for malt in the United States is for the purpose of making the lighter, lager beers. These beers require malt made from the six-rowed Manchurian type of barley, on account of its high diastatic power. The American likes his beer ice cold; therefore the brewers must avoid the use of malt that will not make a perfect conversion in the brewing process. It is found that malt made from barley of the six-rowed type, only, is satisfactory.

The National Barley Committee in Canada has advocated the sowing of the six-rowed Manchurian types of barley on account of their adaptability to the malting of lighter beers. It is fortunate for Canada that this has been done as Canada thus had the goods that importers wanted when the demand came first for malt in 1933, followed also with a demand for malting barley in 1934 and 1936. In the year 1934 Canada exported to the United States approximately four million bushels of barley. During August and September, 1936, the imports of barley by the United States from Canada were approximately four and one-half million bushels with the promise that the demand will still keep up during the next few months.[2] Approximately a quarter of a million bushels of the barley imported during August and September, 1936, came from the Province of Ontario. The balance of it came from the Western Provinces, nearly all of which has moved out from Fort William or Port Arthur via water to United States lake ports. The larger proportion of this went to Milwaukee with Duluth-Superior in second place, followed closely by Chicago.

The six-rowed type of barleys, mostly O.A.C. 21, have been grown successfully in the Western Provinces particularly in Manitoba. Much credit must be given the Canadian farmers for their care in preparation of the soil, in selection of seed, and in harvesting and threshing. Unfortunately, however, climate and soil in Western Canada do not permit the growing of a mellow six-rowed barley such as can be grown in southern Minnesota, Wisconsin, southeastern South Dakota, and in Iowa, as well as in some of the other Central States. The Canadian barley that has been imported into the United States has generally proven satisfactory and much credit must be given the Canadian Inspection Department for its careful inspections which have rendered No. 3 Extra C. W. Barley, Six Row, very satisfactory to American buyers, notwithstanding the fact that it is not quite so satisfactory a malting barley as barley grown in the areas mentioned above. However, the fact that the barley shipped from the Western Provinces has been fairly uniform in quality has enabled maltsters to adapt their malting processes so as to get a fairly uniform quality of malt, which, after all, is an important attribute of malt.

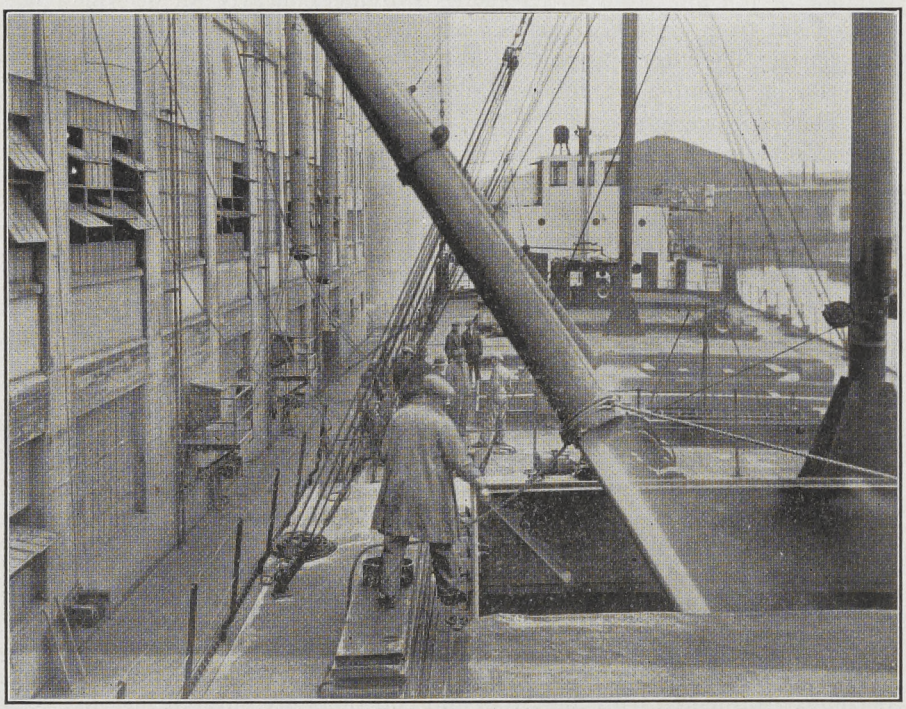
It is the custom in the United States to conduct the trade in malting barley on samples of individual lots. The reputation of handlers of barley becomes established with maltsters and contracts are entered into between them on certain established type samples, these samples often representing only certain individual, specific lots. Type samples of Canadian barley

Editorial note, March 1st, 1937.

2 The imports of Canadian malting barley by the United States from August 1st, 1936, to February 1st, 1937, were approximately eleven and one-half million bushels, practically all of which was shipped before the close of navigation.

as part of the transaction are not now generally demanded as the reputation of the Canadian Inspection Department is quite well established with American maltsters. However, during the current year sellers of barley at times have found it necessary to make certain guarantees as to quality, particularly test weight, in selling Canadian barley to United States buyers. However, these specific terms, which have been insisted on in some instances only, have in no way militated against the ability of Canada to market No. 3 Extra C. W. Barley, Six Row, in the United States.

Looking ahead we can prophesy that the United States will import Canadian barley while the present duty of twenty cents per bushel is in effect, only during such years as there is an actual shortage of malting barley in the United States. This may not be true of malt, as the malting capacity in the United States is still scarcely able to meet the demand, and Canadian maltsters will probably find a market in the United States for a few years to come, provided there is not an unfavorable change in the duties. It must not be forgotten that 1936 was an election year in the United States, and it always happens that the demand for brewery and distillery products during election years exceeds other years.



Loading a special shipment of malting barley for use in the United Kingdom. This was a special lot of No. 3 Extra C.W. barley segregated by the United Grain Growers, Ltd., Winnipeg, Man.

THE EUROPEAN MARKET FOR BARLEY

HENRY GAUER [1]

James Richardson & Sons Limited, Winnipeg, Manitoba

Barley since ancient days has been one of the world's most important cereals. Although quite commonly grown, it does not however enter into the world's trade to anything like the same extent as wheat. There is a greater fluctuation in the export and import of this cereal due to various reasons. Its production is more influenced by the seasons than is wheat, so that there is a greater variation in supply from year to year. It is grown in most countries principally for feeding purposes, and the consumption varies considerably depending on the price levels of hogs and of the substitute feeds, of which there are many, but chiefly corn. The variation in exports and imports is clearly seen in the accompanying statistical statements.

In addition to its use for feeding, barley is largely used for brewing, distilling, manufacture of malt extracts, pot and pearl barley. For these purposes, substitutes are not desired, high prices if necessary being paid for desirable qualities of the needed supplies. In some countries barley meal is used for bread purposes, in most cases as a substitute for wheat when the latter is scarce or high in price. At times, barley has been roasted and used as a substitute for coffee.

Europe produces much the largest percentage of the world's barley crop; at the same time it does nearly all of the importing. Excluding two years in the past ten, imports by other countries have averaged under four million bushels per year. This clearly indicates the importance of the European market for barley.

During the last ten years, European imports have run from a low of 96 million to a high of 185 million, the result of influences already indicated and also of the effects of political action in some of the countries, for economic or other reasons.

The largest and most consistent importers have been but four, Great Britain, Germany, Holland and Belgium. Very little Canadian barley has been sold in Europe to other than these four countries. With the exception of the occasional year when the United States may have had a very short crop, these four countries are Canada's principal markets. Of these countries, Great Britain in recent years has been our best market, one important reason for this being the preference which we have enjoyed over non-Empire countries since the Ottawa pact, this amounting to an advantage of ten per cent of the price. British importations have been chiefly for feed purposes although importations of malting varieties have also been considerable, principally for the distilling and malt extract trades. The brewers prefer malt from home grown barley which is generally of the two-rowed variety, and as very little of our barley is of this variety, any necessary importations must of necessity come from other countries. We have here nevertheless a market that could generally take all of our

[1] Western Manager.

TABLE 3.—CORN IMPORTS, BY CALENDAR YEARS

	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926
Austria	5,563,120	20,225,200	19,368,220	15,348,870	12,263,670	7,270,370	4,910,610	5,707,620	7,978,670	6,856,000
Belgium	31,006,260	29,703,620	29,540,790	33,680,100	32,994,500	23,087,580	23,036,160	22,419,120	31,366,200	24,595,900
Czecho-Slov	6,427,500	8,398,600	7,018,830	12,375,080	26,652,700	10,763,920	7,884,400	10,558,240	15,983,050	12,709,310
Denmark	9,255,600	20,165,210	19,848,120	37,682,290	29,360,820	12,243,660	7,815,840	25,692,860	33,765,800	15,151,760
Finland	2,099,650	4,209,100	2,519,580	1,071,250	771,300	231,390	222,820	299,950	214,250	119,980
France	24,167,400	25,315,780	28,726,640	46,286,570	42,601,470	32,326,040	32,188,920	28,683,790	31,623,300	26,224,200
Germany	11,141,000	15,974,480	10,009,760	29,857,880	19,993,810	25,675,720	26,344,180	50,554,430	83,583,210	27,723,950
Gt. Br. & N. I.	119,011,590	122,748,110	102,608,610	105,625,250	106,525,100	68,594,280	69,828,360	66,014,710	83,883,160	63,812,220
Greece	2,142,500	171,400	1,054,110	5,973,290	762,730	274,240	1,105,530	1,002,690	1,234,080	771,300
Holland	34,939,890	39,310,590	48,849,000	66,331,800	61,961,100	44,564,000	39,164,900	47,863,450	54,590,900	40,536,100
Hungary	9,906,920	..	..	..	4,096,460	394,220	728,450	557,050	994,120	..
Italy	12,795,010	6,444,640	5,082,010	25,315,780	29,052,300	32,771,680	29,883,590	35,565,500	16,308,710	18,991,120
Ir. Free State	11,123,860	12,683,600	11,638,060	22,427,690	22,401,980	14,774,680	14,286,190	15,391,720	15,091,770	7,567,310
Jugoslavia	..	..	..	17,140	59,990	59,990	754,160	1,731,140	248,530	51,420
Norway	5,073,440	5,167,710	6,564,620	6,041,850	7,867,260	5,356,250	3,445,140	4,576,380	5,990,430	4,456,400
Poland	..	102,840	325,660	179,970	908,420	702,740	694,170	2,151,070	5,390,530	857,000
Portugal	728,450	2,913,800	2,313,900	2,553,860	2,219,630	3,282,310	1,731,140	2,648,130	3,599,400	1,242,650
Spain	2,056,800	1,371,200	3,093,770	12,015,140	6,787,440	5,896,160	11,158,140	13,137,810	12,135,120	14,003,380
Sweden	1,696,860	4,285,000	10,446,830	9,512,700	14,003,380	5,287,690	3,050,920	7,498,750	7,198,800	4,370,700
Switzerland	3,813,650	3,462,280	3,256,600	5,630,490	6,796,010	4,764,920	3,882,210	5,381,960	6,067,560	4,336,420
Algeria	68,560	214,250	68,560	197,110	385,650	137,120	25,710	197,110	565,620	265,670
Canada	7,155,950	8,312,900	5,510,510	7,387,340	9,684,100	11,423,810	15,503,130	13,960,530	16,205,870	12,709,310
Cuba	..	..	..	..	?	248,530	951,270	1,251,220	2,819,530	2,639,560
Egypt	51,420	42,850	..	85,700	531,340	77,130	17,140	8,570	8,570	257,100
Japan	4,113,600	..	77,130	2,228,200	3,325,160	2,613,850	1,868,260	1,465,470	1,336,920	934,130
Tunis	68,560	214,250	..	351,370	634,180	197,110	..	1,182,660	1,276,930	171,400
United States	43,278,500	2,999,500	162,830	342,800	617,040	1,559,740	411,360	565,620	5,459,090	1,062,680
Uruguay	?	?	?	?	?	?	282,810	257,100	531,340	788,440
Total	357,686,090	334,436,910	318,084,140	448,519,520	443,257,540	314,579,130	301,175,510	366,324,650	445,451,460	293,205,410

Sanford Evans Statistical Service, Winnipeg.

TABLE 1.—EXPORTS OF BARLEY. (000 Omitted)

FROM:	*1935-36	1934-35	1933-34	1932-33	1931-32	1930-31	1929-30	1928-29	1927-28	1926-27
Algeria.....	1,415	2,453	2,320	320	880	2,640	4,320	5,760	6,320	560
Argentina..	8,428	20,113	23,200	17,520	12,960	11,440	5,120	9,040	10,320	13,920
Canada....	5,783	15,056	1,600	5,200	12,960	18,480	2,480	38,560	25,360	37,280
India.....	73	813	..	..	1,360	640	80	720	8,000	960
Tunis.....	3,468	822	160	4,480	1,680	480	5,280	7,440	1,840	2,400
U.S.A.....	9,283	4,441	5,040	8,800	5,040	10,000	17,360	59,040	34,800	17,280
Oth. Ex. Eu.	10,638	18,702	12,000	13,600	24,800	10,240	9,200	17,600	14,720	16,240
Balkans....	8,185	9,866	30,800	23,920	32,640	70,720	90,480	20,400	27,920	34,400
Belgium....	891	946	1,320	2,800	3,360	2,160	320	160	†	†
Czechoslov.	1,631	2,375	2,240	7,040	4,240	6,000	5,040	3,520	7,040	4,800
Denmark...	3,188	2,912	2,000	960	960	2,480	2,480	2,960	3,120	2,400
France.....	..	5	160	240	160	240	880	640	3,120	640
Germany...	..	5	..	..	80	160	2,240	400	160	80
Holland....	446	404	80	320	560	1,280	960	1,040	720	560
Hungary...	560	193	2,160	2,960	80	1,120	4,560	1,040	2,080	2,240
Poland.....	15,483	14,960	6,960	7,040	6,240	5,440	11,120	8,480	3,040	4,080
Russia.....	‡32,476	7,643	21,040	15,360	35,600	46,800	29,200	..	240	28,000
Sweden....	..	..	..	..	..	..	80	..	..	1,680
Oth. Europe	735	399	80	400	160	400	720	560	1,760	1,360
Total.....	102,683	102,108	111,160	110,960	143,760	190,720	191,920	177,360	150,560	168,880

*1935-36—11 months only.
†Included in Other Europe.
‡Russia for 1935-36—Broomhall's figures, partly incomplete.
Note.—1935-36 and 1934-35 figures are from International Institute of Agriculture; all other years were taken from Broomhall's publications.

TABLE 2.—IMPORTS OF BARLEY. (000 Omitted)

	*1935-36	1934-35	1933-34	1932-33	1931-32	1930-31	1929-30	1928-29	1927-28	1926-27
Austria.....	2,269	3,279	5,200	4,000	4,240	4,480	3,280	2.400	2,880	2,720
Belgium....	18,257	17,670	17,920	18,080	18,720	21,040	15,680	14,400	11,120	11,040
Denmark...	161	2,145	2,720	4,400	7,840	30,000	8,880	1,200	2,080	3,520
France†....	8,722	8,332	7,760	15,360	19,120	15,600	3,360	6,800	1,840	2,640
Germany...	2,926	21,872	15,360	7,520	29,680	35,760	99,440	71,440	84,080	92,960
Gt. Brit.N.I.	43,478	29,823	40,480	27,040	28,080	37,280	28,880	30,000	32,640	28,720
Irish F. S..	877	533	400	240	1,040	880	640	1,040	560	480
Holland....	12,626	12,319	23,040	17,600	18,160	29,840	16,000	17,120	10,080	12,960
Italy.....	..	3,858	2,240	1,920	1,600	1,520	720	800	800	1,040
Norway....	671	349	560	320	6,000	2,160	1,520	1,120	1,280	1,120
Switzerland	5,181	5,617	4,800	8,560	..	5,760	3,920	4,160	2,720	3,200
Esthonia...	..	..	..	..	..	..	160	480	160	80
Oth. Europe	‡1,126	217	..	80	480	960	1,520	2,560	1,680	3,600
Tot. Europe	96,294	106,014	120,480	105,120	134,960	185,280	184,000	153,520	151,920	164,080
Ex. Europe.	1,382	3,832	††3,000	5,440	10,400	3,200	2,800	4,640	5,520	5,200
Total.....	97,676	109,846	123,480	110,560	145,360	188,480	186,800	158,160	157,440	169,280
U.S.A.....	285	11,023								
Total.....	97,961	120,869								

*1935-36—11 months.
†France—10 months.
††Partly estimated.
‡Includes 753,000 for Hungary, 317,000 for Greece, and others 56,000 bushels.
Note.—Imports similar to exports, i.e., 1935-36 and 1934-35 are International Institute of Agriculture; all other years, Broomhall's figures.

surplus, providing that our quality is right and our prices are competitive. For the feed trade, our grain needs but to be reasonably clean; if however we are to supply the distilling and malting trade, our barley must not only be thoroughly clean but must also be true to variety and properly threshed; the extra premium obtainable for such quality will invariably repay our producers for the extra care needed to produce the desired article. The British market is well worth fostering.

Holland, Belgium and Germany also grow most of their malting barleys and import chiefly for feeding purposes; the same considerations as to quality and price apply. As we do not enjoy a tariff preference, competitive conditions for us are much more severe; our exports to these countries are therefore more spasmodic and largely confined to years when we have enjoyed large crops which have had to be sold at moderate prices. Trade arrangements of course play a considerable part in the development of these markets and our lower exports in recent years to some of these countries can largely be attributed to lack of these.

The appended statistical reports will show the world exports of barley by countries, over a period of ten years, also the imports of barley by countries during the same time. This shows the extent of the world's trade in this commodity and the considerable variation that has existed. It will be noticed that Europe ordinarily is almost an exclusive importer. In addition to these reports, a report is also appended showing the corn importations by calendar years over a period of ten years, and with the exception of the occasional year when the United States has been a considerable buyer, these importations have also largely been confined to European countries. As this corn is used chiefly for feeding purposes in these countries, it clearly shows the extent of the available markets for feed in that part of the world and the possibility of extending markets for feeding barley, providing there is a sufficient volume and that prices are competitive.

In conclusion, let me again emphasize the importance of growing good barley that is clean and true to variety, if our markets are to be retained and expanded and best prices realized.

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L'ORGE AU CANADA[1]

L'organisation du travail de recherches et d'expérimentation sur l'orge au Canada

Au cours des quatre dernières années, le problème de l'orge au Canada a été étudié attentivement sous tous ses aspects: recherche scientifique, expérimentation, production, utilisation et débouchés.

Le Comité National de l'Orge fut créé en 1933 sous l'initiative et la direction du Comité Consultatif National des Services Agricoles afin de promouvoir selon un plan d'ensemble l'industrie de l'orge au Canada. Tous les organismes intéressés de près ou de loin à cette industrie prirent part à cette campagne. De nombreux comités et sous-comités furent organisés pour étudier tous les aspects du problème: création de nouvelles variétés d'orge, sélection, essais de variétés, division du pays en régions adaptées à cette culture, organisation des débouchés domestiques et étrangers, transport, nettoyage, classement, valeur industrielle et alimentaire, publicité, financement, etc. Rien ne fut oublié ou négligé. Nous avons là un exemple frappant des résultats qu'on peut obtenir dans un domaine particulier quand tous les intéressés combinent leurs efforts pour résoudre un problème complexe.

Progrès accomplis dans la production de l'orge

Des progrès importants furent accomplis depuis 1930 dans la production de l'orge de meilleure qualité. La statistique de la Division Ouest de l'Inspection des grains montre que le pourcentage des quantités d'orge dans les classes supérieures au No. 3 C.W. qui était de 8% en 1930-31 s'éleva graduellement à 17½% en 1931-32, à 30% en 1932-33, à 29% en 1933-34, à 35% en 1934-35, à 32% en 1935-36 et à 68% pour les arrivages du 1er août au 17 septembre, 1936.

Certaines variétés d'orge ne conviennent pas à l'industrie du malt. D'autre part, l'orge peut être impropre à l'industrie du malt si elle contient un excès de grains d'autres céréales ou de graines de mauvaises herbes, des grains avariés par la carie ou le charbon, et trop de grains cassés. Ce sont là des pertes qui pourraient être évitées assez facilement. Les prix relativement élevés pour l'orge à malt depuis deux ans sont dus principalement à la demande des Etats-Unis dont la production fut réduite par la sécheresse au cours des saisons de 1934 et 1936.

L'un des meilleurs moyens de développer des débouchés pour l'orge à malt outre-mer est d'obtenir un produit d'aussi bonne qualité que possible.

Essais d'orge à malt

La valeur de l'orge à malt est déterminée principalement par sa capacité à transformer l'amidon des matières employées pour la brasserie ou la distillerie et la proportion d'extrait de malt fournie par une quantité donnée d'orge. Les essais d'orge ont aussi pour objet de déterminer les facteurs suivants:

1. La valeur relative du malt provenant de différentes variétés d'orge déjà cultivées et des nouvelles variétés.
2. Les régions les mieux adaptées pour la production de l'orge à malt.
3. Les variétés qui conviennent le mieux à chaque région.
4. L'influence des diverses méthodes culturales sur les qualités de l'orge comme source de malt.

L'orge Trebi et la Wisconsin no. 38 ne semblent pas bien adaptées à la production de l'extrait de malt. Bien qu'il existe une corrélation entre un haut pourcentage de protéine et un faible percentage d'extrait de malt, il ne s'ensuit pas nécessairement qu'une variété ayant un haut pourcentage de protéine ne soit pas une bonne variété d'orge à malt; tel est le cas de la Peatland.

[1] Ce numéro constitue un véritable traité sur l'orge au Canada. Le résumé français ne fait ressortir que les principaux points traités au long dans les articles précedents. Ce résumé a été preparé par la rédacteur français, M. A. Gosselin.

La région exerce assurément une certaine influence sur la qualité de l'orge à malt. Ainsi certaines variétés d'orge cultivées dans l'Est produisent une plus grande quantité d'extrait de malt que ces mêmes variétés dans les régions de l'Ouest. Il y a aussi des variations notables dans diverses localités. Cette variation d'une même région dans la quantité d'extrait seon les régions existe aussi pour les diastases et la quantité de protéine.

L'orge à malt—Fabrication et Utilisation

La fabrication du malt avec l'orge remonte assez loin dans l'histoire mais ce n'est que vers 1833 que Payen et Persoz appliquèrent des procédés scientifiques à cette industrie. Vers 1880 le français Nicolas Galland découvrit un procédé pneumatique pour contrôler la température et le degré d'humidité au cours de la fabrication du malt.

La transformation de l'orge en malt dépend pour beaucoup de la vitalité de l'orge employée et de son pouvoir germinatif qui ne peut être inférieur à 96%. L'orge à six rangs du type Manchourie est celle qui est principalement employée sur ce continent. Elle doit être riche en hydrates de carbone et ne pas contenir une trop forte proportion de protéine.

L'orge utilisée pour le malt doit être fraîche, saine, bien mûrie, bien fournie, tendre, exempte de maladies fongeuses et non brisée. La fabrication du malt comprend quatre opérations: Le nettoyage mécanique, le trempage ou macération, la germniation et le séchage.

Le malt d'orge sert dans l'industrie de la brasserie et de la distillerie. Le malt de distillerie diffèrt du malt de brasserie en ce qu'il doit contenir une plus forte proportion de diastases, ce qui exige un traitement un peu différent. On se sert aussi du malt de distillerie pour la fabrication de la yeast et du vinaigre de même que pour certaine boisson non alcolique, café, Postum, maltose, etc.

L'orge pour les porcs

L'orge constitue un des meilleurs aliments concentrés pour l'élevage et l'engraissement des porcs à bacon et, au Canada, cette céréale est cultivée sur une assez grande échelle pour cette fin. Il n'y a pas très longtemps on employait l'orge seulement dans les rations pour la période d'engraissement des porcs. Heureusement de récents essais ont démontré que l'orge pouvait faire partie de la ration des porcs en tout temps, quoique en des proportions variables.

L'orge est plutôt pauvre en protéine et en matières grasses, mais elle est riche en hydrates de carbone. Comme la plupart des céréales, elle contient peu de calcium et de vitamines A et D. Son coefficient de digestibilité qui est de 80 est comparable à celui du blé et du maïs.

Au Canada on préfère l'avoine pour les jeunes porcs bien qu'elle contienne une plus forte proportion de cellulose mais au Danemark c'est le contraire et on leur donne l'orge concassée de préférence à l'avoine. Toutefois la supériorité de l'orge comme aliment pour l'engraissement des porcs est reconnue partout.

L'orge n'est pas cependant un aliment complet et pour obtenir les meilleurs résultats de son emploi il convient de lui ajouter un supplément de protéine sous diverses formes. En tenant compte de ceci l'orge peut former 20% ou plus de la ration de base des jeunes porcs après le sevrage et 70% de la ration d'engraissement. A la suite d'essais recents on recommande les rations suivantes:

Ration de base

	Période de croissance	*Période d'engraissement*
Orge	50	60
Blé	20	30
Avoine	30	10

Supplément de protéine

Tankage 50, farine de poisson 15, tourteau de lin 25, sel iodisé 5, pierre à chaux broyée ou farine d'os 5. Dans la première période on donne 85% de la ration

de base avec 15% du supplément de protéine. Dans la deuxième période on donne 90% de la ration de base et 10% du supplément de protéine. Les sous-produits laitiers peuvent remplacer le supplément de protéine en bonne partie.

L'orge pour les bêtes à cornes

L'orge est largement employée dans les rations pour l'engraissement des bouvillons. Elle donne un bon fini et une chair de bonne qualité. Il est bon de commencer tranquillement et d'augmenter graduellement la proportion de l'orge dans la ration jusqu'à ce qu'elle atteigne les deux-tiers du mélange vers la fin de la période d'engraissement. D'après Morrison de nombreux essais comparatifs avec l'orge et le maïs ont démontré que l'orge égalait le maïs pour l'engraissement des "steers". Pour les vaches d'élevage, l'orge peut former de un tiers à une demie de la ration de concentrés. En dehors de la période du vélage, l'orge peut former environ le tiers de la ration des concentrés donnés aux vaches laitières en lactation.

L'orge pour la volaille

Les résultats de nombreux essais pour déterminer la valeur relative de divers grains dans l'alimentation de la volaille montrent que l'orge, le maïs, le blé et l'avoine ont à peu près la même valeur pour l'alimentation des poulets durant la période de croissance pourvu qu'on tienne compte de certaines déficiences ou de certains caractères individuels de ces grains. Ainsi le maïs est plus riche en vitamine A que l'orge, le blé et l'avoine. L'avoine non écalée contient plus d'écorce que le maïs et le blé. L'orge quoique à un degré moindre que l'avoine est aussi plus grossière que le maïs et le blé. Le taux de mortalité est plus élevé avec le blé qu'avec les autres grains.

Pour la ponte, le maïs a plus de valeur que l'orge, le blé et l'avoine à moins de donner un supplément d'aliments riches en vitamine A avec ces grains. Pour l'engraissement, le maïs est supérieur aux autres grains; le blé vient en second lieu, puis l'orge et l'avoine.

Les débouchés pour l'orge produite au Canada

Depuis quelques années un travail important a été accompli au Canada pour créer de nouveaux débouchés pour l'orge. On peut les classer suivant leur ordre d'importance comme suit: l'alimentation du bétail, l'exportation et la fabrication du malt. Durant la période 1930-35 la quantité d'orge produite au Canada servait à l'alimentation du bétail dans des proportions variant de 52% à 68% tandis que l'exportation absorbait des quantités de 2% à 19% et la fabrication du malt 2% à 7%. Le reste était employé pour diverses fins: semence, réserve, déchets, etc.

Il n'y a pas de doute qu'une plus forte quantité d'orge pourrait servir à l'alimentation du bétail mais il y a là certains facteurs variables qu'il est difficile de contrôler.

Le marché américain pour l'orge produite au Canada n'est pas très stable et regulier. Il varie avec l'importance de la récolte d'orge aux Etats-Unis. Depuis 1933 la fabrication de la bière a pris un grand développement aux Etats-Unis qui transforment environ 75,000,000 de boisseaux d'orge en malt chaque année. Quand la récolte d'orge est faible aux Etats-Unis comme en 1934 et 1936, ce pays importe des quantités importantes de cette céréale. Toutefois, il existe un droit d'entrée de 20 cents par boisseau sur l'orge canadienne et à moins que le prix de ce grain soit assez éléve aux Etats-Unis, il n'est pas profitable de l'exporter. Comme le droit de douane sur le malt canadien exporté aux Etats-Unis n'est que de 14 cents par boisseau, il est plus profitable d'exporter le malt que l'orge elle-même. L'orge canadienne à six rangs est appréciée aux Etats-Unis pour la fabrication du malt et il convient de n'exporter qu'un produit de bonne qualité pour maintenir ce débouché.

L'Europe constitue le principal marché pour l'orge, soit pour l'alimentation du bétail, soit pour la brasserie et la distillerie. Le Royaume-Uni, l'Allemagne, la Hollande et la Belgique sont les pays qui importent le plus régulièrement l'orge en grande quantité. C'est dans ces pays que le Canada exporte le plus d'orge sauf aux Etats-Unis quand cette récolte y est faible.

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